THE

ELECTRICAL REVIEW.

VOL. XLV. SEPTEMBER 8, 1899. No. 1,137.

CONTENTS:

	PAGE
The Distribution of Electricity and Home Industries	381
Mosaics	382
The Differences of Experts	382
Kashmir Electric Railway Scheme (*illustrated*)	383
The Generation of Power for Electric Traction (*illustrated*) (*concluded*)	384
Indispensable Accessories of Electric Traction (*illustrated*) (*continued*)	386
The Purification of Feed Water (*illustrated*)	387
The Glasgow Electrical Tramways Contract	387
The Report of the Pacific Cable Committee (*concluded*) ...	389
Fly-wheel Power of Motors...	390
Limited Electric Stations	390
Correspondence:—Renewable Lamp Company	392
"The Value of Electrical Treatment"	392
Stresses in Steam Engines for Electric Traction	393
The Utilisation of Waste Heat from Flue Gases	394
Economy in the Use of Superheated Steam	394
Business Notices, &c.	395
Sheffield Corporation Tramways (*illustrated*)	399
Notes	407
City Notes	409
Traffic Receipts	410
Stocks and Shares	410
Share List of Electrical Companies	411
Market Quotations	412
Some Forms of Magnetic Separators, and their Application to Different Ores (*illustrated*) (*concluded*)	413
The Synchronising of Alternators (*illustrated*)	416
Intermediate Receivers on Electrical Traction Engines ...	417
The Candle-Power of Arc and Incandescent Lamps	417
Reviews:—Analyses Electrolytiques	418
The Electrical Engineer's Central Station Directory ...	419
New Patents	419
Abstracts of Published Specifications	419

THE

UNIVERSAL ELECTRICAL DIRECTORY

1899

Edition

Price 6s.

NOW READY.

H. ALABASTER, GATEHOUSE & CO.,

4, LUDGATE HILL, LONDON, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON.

Telegraphic Address: "AGENCY, LONDON," Code A B C.

Telephone No. 968 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free per Year, 19s. 6d. To all *other countries*, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 2s. or Free by Post (in Great Britain), 2s. 6d

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU 22, Rue de la Banque. *Berlin:* ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office London, to be made payable to Mr H. ALABASTER, 4, Ludgate Hill, E.C.

THE DISTRIBUTION OF ELECTRICITY AND HOME INDUSTRIES.

IT was once remarked by a very eminent man in this country that the distribution of electricity might prevent, to some extent, the aggregation of workpeople which we witness to-day in the great factories and workshops. Although it might appear an ideal state of existence to go back to the time when the weaving and kindred industries were carried out in the homes of the people, there is little doubt that the question of production might be very seriously influenced. There is a good deal of work which is capable of being carried on in the homes of the people, and if a power of any description, that was easily regulated and controlled, were available, it could hardly be doubted that there might be considerable extension of home work. Undoubtedly, small industries have been affected by the introduction of electric power, and an investigation into the uses of electricity in many of our large towns, even with the limited work that is being done, would be distinctly interesting. We are looking forward to the day when the complete schemes of the great power companies will enable electricity for power purposes to be obtained in places that are removed from the great industrial centres, but which, nevertheless, carry on small home industries. In these days, when the attention of most people has been directed to the distribution of large powers over long distances, it is not surprising that most interesting examples of transmitting electricity over small areas have escaped attention. One of the most interesting examples of power transmission is one in the district of Saint Etienne, where a most material effect has been produced upon an industry that has been for the most part carried on by the workpeople in their own homes. The ribbon industry of the district of Saint Etienne is one of the most ancient in France, and it will afford some idea of the importance of the industry when it is mentioned that in the district surrounding Saint Etienne there are probably 30,000 looms, there being 15,000 in Saint Etienne alone. Before the introduction of electricity, these looms were chiefly driven by hand, the weavers employing occasionally skilled assistants, or, in many cases, using the skill of members of their families. Some years ago an interprising electric company founded electricity works in the district, which were originally situated at Saint Victor sur Loire, some eight or nine miles from Saint Etienne. The original plant consisted of three turbines of 300 H.P. each, a stand-by being provided in the shape of two 300-H.P. engines, which were utilised in the event of a water-power failure. Some time after this company started operations it was incorporated with a rival concern, and at the present moment the company is supplying power over a district of some 24 miles in extent, power being chiefly employed for the purposes of driving weavers' looms. The system of generating and distribution is the three-phase, and current is conveyed throughout the district by 68 miles of wire. Spread over the district are 30 sub-stations, in which transformers are placed to reduce the voltage of the current, which is delivered at 5,200 volts, to a pressure of 190 volts for motive power and 110 volts for

lighting purposes. The total power of the plant employed by the company at the various generating stations amounts to 2,000 H.P. Throughout the district there are 8,000 lamps in use, and 2,500 looms are now being operated by means of electric motors. On an average a ribbon loom requires ¼ H.P., and the charge to each consumer for the power necessary to drive a loom is £4 1s. 6d. per annum, or 8s. per month. From all accounts it is apparent that the ribbon industry has been materially affected by the introduction of electric power, and the output of individual looms has been greatly increased since the introduction of the electricity works.

MOSAICS.

Sir William Preece, as President of Congress of the Sanitary Institute, last week delivered an address at Southampton to upwards of 1,700 delegates, on the advantages of pure air, pure water, pure food, pure dwellings, and pure bodies. Following the precedent of another President, he made frequent use of Biblical allusions; the address was, in fact, an appreciation of the skill of Moses as a sanitary engineer. Moses, according to Sir William Preece, was the greatest sanitary engineer the world has known, for in the regulation of the food supply of the Israelites was displayed, in the opinion of Sir William, that profound knowledge of the hygienic requirements of Eastern nations which has determined the healthy and cleanly lives of the Jews at the present day. To Sir William, the book of Leviticus is a treatise on hygiene, and the Jews the cleanest race on earth. The pity is that they don't all look it.

It must be confessed that there are many reasons for objecting to Biblical allusions when they form the basis of a presidential address to a non-religious society like the Sanitary Institute. Unless very carefully handled, such allusions may easily be misunderstood; they are nearly always in questionable taste, and they are nearly always fallacious. The fallacy of upholding Moses as the founder of cleanliness, is obvious; for the grown-up daughter of Pharoah was taking her customary morning bath before Moses was out of his little bulrushes. Indeed, it was on her way to the bathing machines that she discovered the baby; a proof that not only bathing, but "mixed bathing," was common in the earliest dynasties of the Egyptians. Later on in life, it must be admitted, Moses showed some proclivities towards hydrostatics, and evinced some marvellous knowledge in matters of commissariat. Unfortunately it is futile for a modern sanitary engineer to follow the methods of the great Levite, for he was favoured in his foraging by phenomena peculiar to the exigencies as they appeared—phenomena which in the World's history are never likely to recur. The modern engineer is, so to speak, not to the manna born.

There is comfort in the thought that, of all the Institutes, one is sanitary; but to the casual observer it must seem something of a mystery that this one Institute should choose its president from the ranks of electrical engineering. It is really wonderful to contemplate how much the world appreciates the intelligence of the modern electrician. Search the universe up and down, from Glasgow to Cape Town, from New York to Southampton, and you will find that where experts, diplomatists, presidents, and company-promoters are wanted, the electrician is always there. It is not too much to say that if the General Staff of France became disrespected to-morrow, if Kruger ceased from Krugering, if the Czar abdicated and went to Paris, a telegram addressed to the Electrical Engineers would ensure that every gap in the political fence should be filled, and that the world should still go on, talking.

In the case of the Sanitary Institute, however, it must be admitted that they showed a good deal of wisdom in going far afield for fresh ideas. It is a question of healthy homes, healthy workshops, healthy workhouses, healthy churches, healthy prisons, healthy post-offices; and it is improbable that any one man should have experience of all of these at once. As an electrician, Sir William Preece was able to call attention to the advantages of electrical methods of ventilation and illumination, and he did well to emphasise the merits of dust-destructors. We may smile at his wanderings in the wilderness of Shur, but there is no doubt he imparted some freshness to the bitter waters of the usually dull proceedings; and in addition he gave the Sanitary Congress some good practical advice in directing their attention to the housing of the poor.

THE DIFFERENCES OF EXPERTS.

The Newcastle Corporation, which has been for something over two years violently agitated on the subject of overhead tramways, and its Tramways Committee has arrived at last at a sensible decision. The main question before the Council for some time past has been whether it was advisable to adopt a overhead or a conduit system in the central streets; but on the advice of one of its experts, it has decided to equip the central portion of the town temporarily with overhead wires. The Committee has arrived at this decision in a somewhat curious manner. It has had abundant expert testimony on the subject. Prof. Kennedy was commissioned to provide a report, Mr. Charles Hopkinson was asked to give an opinion, and Mr. Laws, the borough engineer, was likewise requested to give his opinion. In a multitude of counsellors there is wisdom, but there is also considerable difference of opinion. Prof. Kennedy, in his report, follows fairly closely the views which he put forward in his report to the London County Council. He points out that there is no difficulty in obtaining successful results from a combined system of overhead and conduit, and he takes a favourable view of the surface contact system, and declares that it would not cost more per mile than a really well-arranged overhead system. On this point we imagine there will be considerable divergence of views. Apart from the question of whether it is possible at the present moment to obtain a surface contact system which may be expected to meet the very trying conditions of street life, it is doubtful whether a contact system could be equipped for anything like the sum that is necessary to put up the best overhead system in existence. From an intimate knowledge of all the contact systems which have been brought to the notice of tramway authorities, we do not think that any municipality would be justified in spending a single penny on them. Clearly and emphatically, we state that such systems have not gone beyond the experimental stage, and if a municipality adopts surface contacts, it ought clearly to recognise that it is doing nothing else but carrying out what might prove to be very expensive experiments. The advice of Mr. Charles Hopkinson to the Newcastle Corporation is entirely contrary to, and probably more precise than, that of Prof. Kennedy. He states, on the subject of contact systems, that "The greatest working difficulties would arise after a period of use." He truly points out that the system had not been in commercial use for a long enough time to demonstrate that the possibilities of breakdown were overcome; and where such systems were in use the climatic conditions were less severe than in Newcastle. It is quite possible that a surface contact system may be evolved in the next year or two which will justify its adoption, but at the present moment we should counsel hesitation on the part of the municipality to adopt what at the best must be an expensive system. It is satisfactory to find that Mr. Charles Hopkinson's advice to erect the overhead trolley system in the central portion of the town has been accepted; at the same time we should just like to point out that the difficulties of a municipality when considering electric tramway matters are very materially added to if they seek too much advice. In this particular case both Prof. Kennedy's and Mr. Hopkinson's reports were submitted to Mr. Laws, the city engineer, and the consequence is that he agrees with neither. Indeed, Mr. Laws goes so far as to state that the best plan will be to put down a surface contact system at once in the central streets. With such marked differences of opinion before it, it is satisfactory to find that the Newcastle Committee can arrive at what must be held to be a reasonable decision.

KASHMIR ELECTRIC RAILWAY SCHEME.

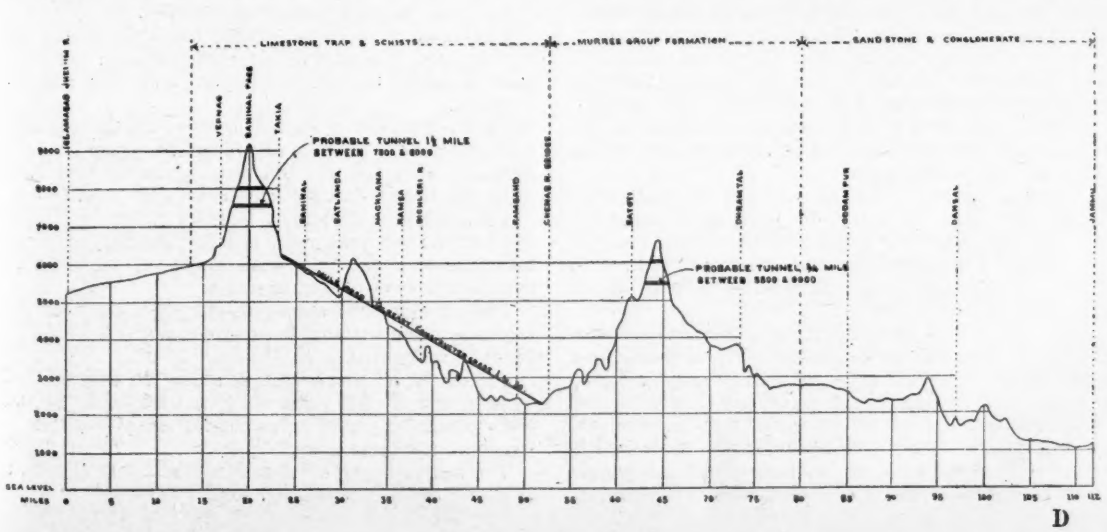
Speaking politically, the area covered by the title Kashmir extends to about 300 miles east of Rawal Pindi, and to about the same distance north of Lahore, the western and southern frontiers being distant from these places about 30 and 70 miles respectively. What, however, is historically and geographically known as Kashmir is a valley some 70 miles by 20, having a general level of 5,000 feet above the sea, lying north-west and south-east, and surrounded on all sides by mountains, some of which attain an altitude of 16,000 and 17,000 feet.

The Valley of Kashmir is watered by the Jhelum, which, rising in the south-east, flows into the extensive Wular Lake, and then making an abrupt turn to the west, flows down into the plains of India through a series of gorges. The capital, Srinagar (pronounced Shrinugger), is situated on the Jhelum, almost in the centre of the valley.

Srinagar is accessible from the south by the gorges of the Jhelum, and by a limited number of passes which cross the main mass of the Himalaya mountains. A cart road has been constructed along the Jhelum route, the distance between Srinagar and Rawal Pindi being 198 miles. Before this road was made available for wheeled traffic, the bulk of communication was carried on across the Pir Panjal and the Banihal Passes, the former being 11,400 feet, and the latter 9,700 feet at summit.

Notwithstanding the formidable natural obstacles in the way of railway communication between the Valley of Kashmir and the outer world, various projects have from time to time been brought forward with this end in view. In 1886 General de Bourbel directed an investigation into the possibilities of establishing a railway, the routes considered being (1) from Rawal Pindi, on the North-Western Railway, up the Jhelum Valley, *viâ* Abbottabad, with an alternative route starting from Mandra, 20 miles lower down the line; (2) *viâ* the Pir Panjal Pass, and (3) *viâ* the Banihal Pass. In 1890 the Jhelum Valley route was surveyed, and estimates prepared, but the cost was considered to be too great, and the scheme was abandoned. At the same time General de Bourbel reported in favour of the Banihal route. The matter was, however, not considered again seriously until recently, when Mr. M. Nethersole, State engineer to the Kashmir Durbar, brought forward a proposition for working the line by electricity, with proposals as to the route to be adopted differing considerably from those hitherto suggested. The Indian Government has considered Mr. Nethersole's report, and has given formal sanction for the commencement of the necessary survey.

The accompanying map indicates the general alignment of the proposed railway, and the section is that along the existing mule track. The line, which will probably be of 2 feet 6 inches gauge, starts from Jummu, the second capital town of the State, which is already connected by rail with the North-Western system. Jummu is situated nearly at the junction of the rivers Tawi and Chenab, at an elevation of 1,000 feet above sea level, and it is at this point that the boldness of Mr. Nethersole's plan becomes apparent, for he


LIMESTONE TRAP & SCHISTS
MURREE GROUP FORMATION
SAND STONE & CONGLOMERATE
PROBABLE TUNNEL 1½ MILE BETWEEN 7800 & 9000
PROBABLE TUNNEL 3¼ MILE BETWEEN 5800 & 9000
SEA LEVEL
MILES

D

proposes to leave the valley of the Chenab and strike up the northern slopes of the Tawi valley, passing through Udhampur and crossing the Bototi Pass at an elevation of 6,000 feet, and descending again to meet the Chenab at Ramband.

There appears to be abundant reason why this plan should in the end prove less costly and more satisfactory than that originally suggested by General de Bourbel, who contemplated working up to Ramband by the east bank of the Chenab. The distance from Jummu to the summit of the Bototi is estimated at about 65 miles, with grades averaging 1 in 30, but rising to as much as 1 in 20 for part of the way. The descent to Ramband would be made by a grade of 1 in 30 extending for about 25 miles.

Ramband will in all probability be selected as the point where the larger part of the power required for working the line will be generated. The report gives particulars of as many as 11 places within reach of different points of the proposed route where water-power is available. Of these, Ramband is considered to be the most favourably situated. It is actually on the line; it is about midway between Jummu and Srinagar, and there is a practically unlimited amount of water-power, the minimum discharge of the Chenab at Ramband being estimated at 6,000 cubic feet per second, with an average fall of 20 feet per mile.

On leaving Ramband the line follows the existing mule road up the steep ascent of the Bichlari valley for a distance of 27 miles at a grade of 1 in 30. On nearing the top the grade will be increased to 1 in 20 for about 10 miles, and the actual summit pierced by a tunnel of 1½ miles in length, at a height of 8,000 above the level of the sea. Within a short distance of the tunnel the head waters of the Jhelum are met with, and it is estimated that 1,000 H.P. is available at this spot. The importance of having water-power at this elevation will be appreciated when the question of the transmission for working the heavy grades at each end of the tunnel is gone into.

After quitting the northern exit of the tunnel the line descends to Islamabad in the Valley of Kashmir by a rapid fall of about 2,500 feet in 10 miles. The remaining section of the route is practically level, the distance into Srinagar being 45 miles, making in all a length of 180 miles from Jummu.

In forming an estimate of the amount of power that will be required, Mr. Nethersole has calculated that the probable traffic could be dealt with by 10 trains of 100 tons each per day, and that it would be necessary to provide turbines of not less than 5,000 H.P. This estimate of power, as is carefully stated in the report, is based on very rough approximations, and will have to be checked, and revised if need be, when the whole question of the electrical equipment is gone into in detail.

An average speed of 12 miles an hour over the whole line is recommended. This involves large variations of speed according to the grade upon which the train may happen to be running. Thus on a grade of 1 in 20 the estimated speed is 8 miles an hour, while on a level it exceeds 20 miles an hour. These conditions of working raise some interesting points in connection with the design of the controlling system, especially if polyphase motors are to be used, which is almost a foregone conclusion.

The financial probabilities of the scheme are promising. Taking the working expenses at 60 per cent. of the gross revenue—a high figure where the power is obtained entirely from water—it is estimated that the net revenue will represent 8·8 per cent. on the maximum and 13·2 per cent. on the minimum capital cost.

The scheme, as it is presented in the report, is altogether a remarkable one, and we congratulate Mr. Nethersole on having convinced the Government of India of its soundness. There are no doubt technical difficulties, but they are of the same order as others which have been met with and successfully overcome. To the professional mind the scale on which electrical traction will be employed lends a peculiar interest to the undertaking, while the political and commercial results of the new railway must attract public attention to it in no ordinary degree.

THE GENERATION OF POWER FOR ELECTRIC TRACTION.

By J. GRAY SCOTT.

(*Concluded from page* 220.)

In dealing with the subject of the generation of power, no treatise would be complete without reference to the machinery installed at the generating station.

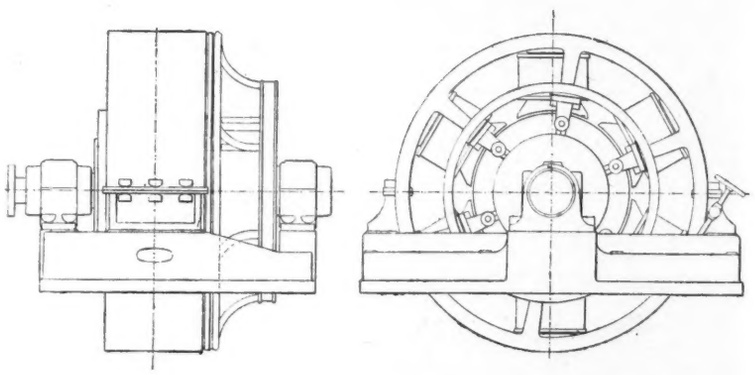
The engines at Bradford are of the well-known Willans central valve type working triple expansion at a pressure of 180 lbs. per square inch.

The I.H.P. of each engine is 600, at or about 300 revolutions per minute.

The satisfactory working of these engines, even under the stringent conditions associated with traction work, goes to prove the high state of efficiency both as regards working and governing which has now been attained, and it is more than probable, that with the development of traction work, high speed engines will continue to be very largely employed.

These engines are too well-known to require description.

The dynamos to which they are coupled offer considerable interest however, being at the time of their installation the largest continuous current generators manufactured in this country; the newer type has not, so far as the author is aware, been previously described.



The general appearance of these machines may be seen from the side and end elevations reproduced herewith.

The field-magnet yoke is nearly 8 feet in diameter, and the machine stands some 6 feet 6 inches from the floor level.

The yoke ring and poles are of cast-steel.

The armature, which is slotted, has a six circuit single winding and is nearly 48 inches in diameter; the commutator is about 36 inches diameter and has some 324 segments.

There are six sets of carbon brushes—five in each set, the connecting cables being carried round the outer ring of the circular brush rocker to which also the brackets carrying the brush spindles are fixed—but insulated therefrom.

The brush gear carriage is mounted on the periphery of the field-magnet yoke ring, and the necessary adjustment may be made by the hand wheel shown on the lower right hand extremity of the end elevation.

The machine is on a separate bedplate from that of the engine, and the armature has bearings of the swivelling and self-lubricating type.

The output for which each generator is designed is 750 amperes at 500—550 volts, which it need hardly be said is easily obtainable—moreover, a considerable overload has been sustained at various times.

The weight of one of these dynamos is over 21 tons, that of the armature being about 7 tons.

The magnet coils are compound wound, the shunt winding alone being used when the machine is employed for lighting —the series coils being requisitioned only for traction supply.

The six coils of the shunt winding are connected in series and have a total resistance of about 41 ohms.

The resistance of the armature (from brush to brush) is less than $\frac{1}{100}$th of an ohm.

In tests of two machines by Hopkinson's method the following figures were obtained :—

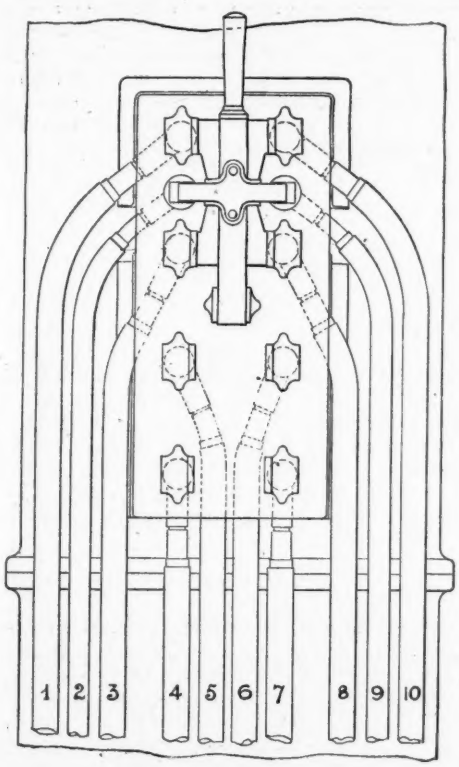
At quarter load, 90·5 per cent.
At half load, 94·25 per cent.
At full load, 95·5 per cent.

Presuming the machines to be of equal efficiency, we get a commercial efficiency of each machine of

97·7 per cent. at full load.
97 per cent. at half load.
95·1 per cent. at quarter load.

In a previous section the author pointed out the importance and convenience of interchangeability of the generators in a combined lighting and traction station.

In order to effect this as may be desired each machine has fitted a change over switch as shown in the following drawings :—



The switch is of course double-pole, the two pairs of inner contacts being connected to positive and negative dynamo terminals respectively ; of the outer contacts, the upper pair are connected with the positive and negative bus bars respectively of the traction switchboard, while the lower pair are connected with the positive and negative bus bars respectively of the lighting switchboard.

In the position shown, the switch would connect the generator with the traction system, the series coils being now in circuit and the equaliser switch closed.

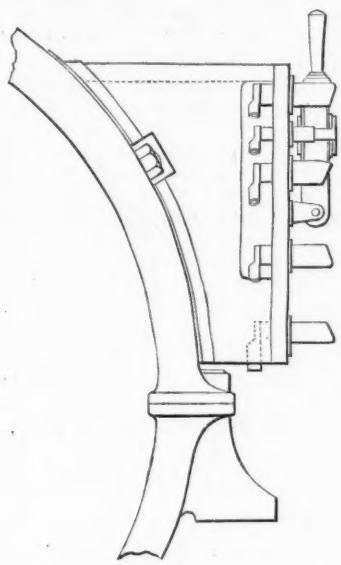
This switch is intermediate between the two upper pairs of main contacts, and its function is simply to connect together the positive brushes of those machines running in parallel on the traction system, and thus obviate the possibility of reversal due to the series winding.

Connection is sometimes made from each of these switches to what is called the equalising bar on the switchboard, but more often is simply connected to a cable in close proximity to the various machines and which equally well performs his function.

Referring to the cables which may be seen passing downwards from this switch it might be well to indicate their connections passing from left to right as numbered.

No. 1 connects the top left-hand contact to the positive bus bar on the traction board, through the series coils on the field magnets.

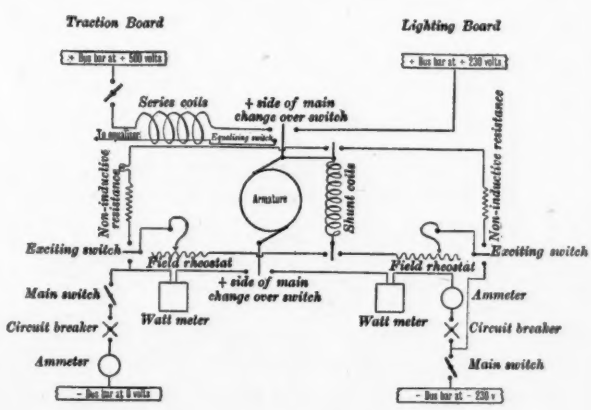
No. 2 connects the equaliser switch to positive brush for equalising when two or more machines are running in parallel.



Nos. 3 and 5 connect the two intermediate left-hand contacts to positive pole of dynamo.

Nos. 4 and 7 connect the two lower contacts to positive and negative bus bars respectively on the lighting switchboard.

Nos. 6 and 8 connect the two intermediate right-hand contacts to negative pole of dynamo.



No. 9 connects equaliser switch to equaliser bar or cable.

No. 10 connects top right-hand contact to negative bus bar on the traction board.

The accompanying diagram clearly sets forth the suitable connections for the interchange.

In conclusion, the author has to express his appreciation of the facilities afforded by his late chief, Mr. Gibbings, of Bradford, in the preparation of the foregoing matter.

The thanks of the author are also tendered very sincerely to those of the staff at Bradford who were good enough to render him assistance, and also to Messrs. R. W. Blackwell and Co. and Messrs. Siemens Bros. & Co., for kindly supplying blocks and drawings.

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 351.)

Mechanical contact bonds constitute, on the contrary, a very numerous class, which falls naturally into two divisions (multiple and simple bonds), the first sub-divided into polymetallic and monometallic, and the second into composite and uniform, in accordance with the character and condition of the metal or metals used in their construction.

The "American solid bond" and the "American flexible bond" are multiple polymetallic bonds, where ordinary steel wire and stranded steel wire respectively constitute the bond (figs. 83 and 84), connection being made with the rail web

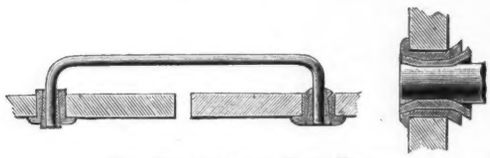


Fig. 83.—American Solid Bond.

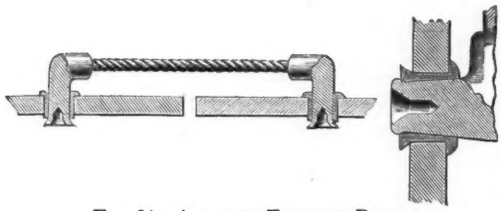


Fig. 84.—American Flexible Bond.

in the first case through tapered copper bushings and sleeves, contact being ensured by driving home the bushings, while in the second the stranded wires are gathered into the thimble ends of conical copper bushings, which are expanded by driving a conical wedge home in the opposite end, when they are passed through the sleeves lining the holes in the rail webs. The defects of these are practically the same as the preceding ones, multiplicity of gaps, deficient capacity, and excessive length.

In the "Grauten bond" ordinary steel wire again composes the bulk of the bond, held in clips with grooved heads riveted through the web, as shown in fig. 85. These clips are

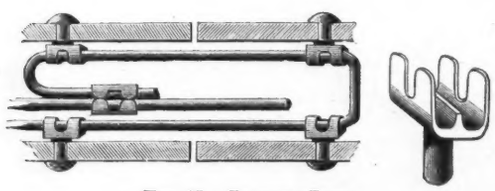


Fig. 85.—Grauten Bond.

of a composition rich in copper. The objections to this bond are also deficient capacity, excessive length, and multiplicity of gaps.

The "Stern & Silverman bond" substitutes a copper wire for the bond proper. This is held in a steel chuck screwed, split, and tapering at one end, on which a binding nut is passed. The chucks are screwed into the web, the copper wire passed through and secured by the binding nut, screwed over the tapering end. The objections to this bond are multiplicity of gaps and deficiency in closeness of contact, the contact between the chucks and the web being necessarily loose and subject to ready oxidation, and that between the copper bond and the chucks being almost as bad. The length is also objectionable on the ground of cost. (Fig. 86).

The "Bryan bond" is another multiple polymetallic bond belonging to Group A. Here the wires composing the bond are clipped between two corrugated washers, one of steel and the other of copper, contact depending on the screw pressure of the bolt passing through these and the rail webs and on con-

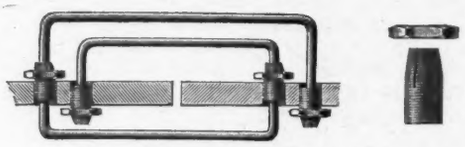


Fig. 86.—Stern and Silverman Bond.

dition of the surfaces. In practice, the closeness of contact cannot be secured, nor can oxidation be prevented in the excessive number of gaps.

Among multiple monometallic bonds, of which steel is the metal used, may be mentioned the "West-End bond" and the "Ohio Brass Company bond," in which steel wire composes the bond proper, the connections being made with the rail webs through tapered steel bushings and caps respectively, which are driven forcibly home. Their defects depend upon deficient conductive capacity and excessive length of the wire and multiplicity of gaps. The principal multiple monometallic bonds in which copper is the metal used are the "Johnson" and the "Columbia" bonds. The first (fig. 87) consists of five parts, a long copper rod, ends bent

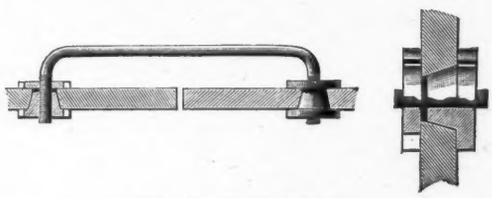


Fig. 87.—Johnson Bond.

at right angles and screwed, two conical tapered nuts, and two flat nuts. The latter are first screwed on the ends, which are then passed through the tapered web holes, and the conical nuts are then screwed home, making the contacts and fixing the bond. The objections are: multiplicity of gaps, impossibility of producing really tight contacts, and therefore of protecting contact surfaces from oxidation.

The Columbia bond has tapered conical heads with filleted base (fig. 88). Two tapered thimbles are inserted in the web

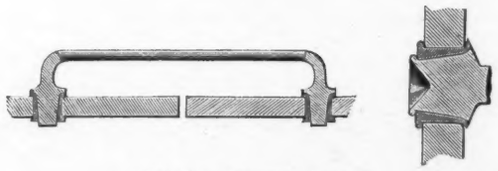


Fig. 88.—Columbia Bond.

holes, the conical heads are passed through these, and tight contact is ensured by setting up the conical head with a plug-headed hammer, or a screw press. The defects of this bond arise from the multiplicity of gaps, and the impossibility of ensuring a uniformly tight non-oxidisable contact throughout the contact surfaces by setting up from one end as described. Mr. Parshall's experiments previously referred to show how considerably the resistance in this bond can vary, the condition of holes and bond remaining constant, owing, presumably, to slight differences in the tightness of the contact surfaces, one being as low as 7·2 microhms, another as high as 9·5 microhms (per two terminals in series), a difference of 32 per cent., the holes being clean and bonds untouched in both cases.

The second or "simple" division of mechanical contact bonds remains to be considered, and this contains some of the most promising forms, as well as some that leave much to be desired. In the "composite" sub-division, one belongs to

Group A (the "Harrington diagonal bond"), and three to Group B (the "Forest City," the "Atkinson and Harrington ball bonds"). The Harrington diagonal bond consists of four copper wires rolled into tapering conical terminals ($\frac{3}{4}$ inch maximum diameter) which are inserted in diagonal holes in the rail foot. This is a composite bond, owing to the difference in conductivity in the rolled ends and the drawn wires, producing an increase in resistance analogous to the introduction of a gap between the rolled and drawn portions. The tapering ends cannot be driven so as not to work loose and do away with closeness of contact and protection from oxidation of the contact surfaces. Its length makes it also a very costly bond.

The Forest City (fig. 89) and Atkinson bonds closely

Fig. 89.—Forest City Bond.

resemble each other in appearance and method of application. They consist of strands of flattened copper wire uniting solid terminals, the first being cast and the second pressed on to the flattened copper strands. They are both composite bonds owing to the difference in conductivity of the copper in the wire strands and in the cast and laminated terminals respectively. This difference with its attendant increased resistance at the junctures of the different forms of copper is liable to be considerably augmented in the case of the cast terminals by these being very liable to contain blow-holes which greatly decrease the conductivity. Both bonds are fastened by the application of pressure through a press (bond welder) or a screw and ratchet clamp. Their defects are those inherent in bonds, the metal composing which is of composite character.

The Harrington ball bond differs from the "Forest City" bond only in having the terminals cylindrically perforated, and in being fixed by expanding them by driving a steel ball into the cylindrical perforation. Its defects arise wholly from the composite character of the metal of which it is composed and the increased resistance produced thereby.

(To be continued.)

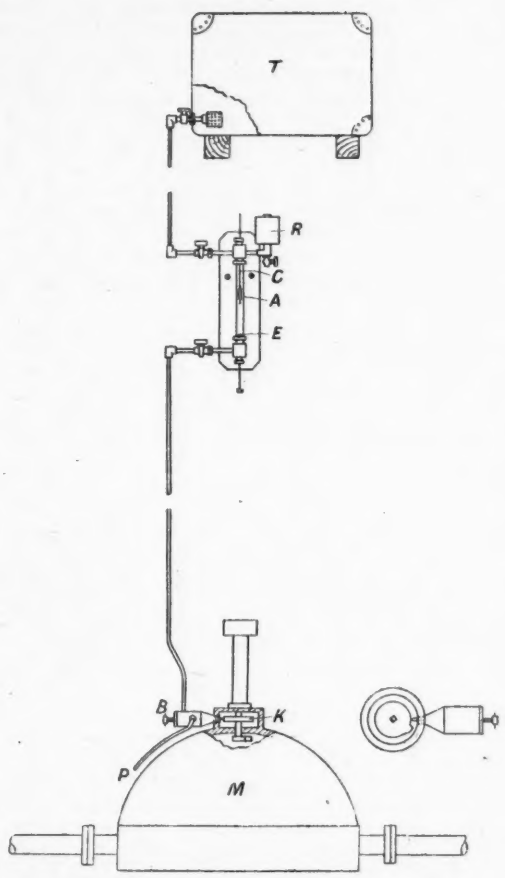
THE PURIFICATION OF FEED WATER.

By T. W. BLOXAM.

When considering the cost of maintenance of steam boilers —which constitutes a large percentage of the works' costs— the most important item, and the one where economy can be most easily effected, is that of labour for cleaning. This can be largely reduced by removing from the feed water the impurities which produce hard scale. The varying amount of attention paid to this point by steam users, drawing their supply of water from the same source, shows a lack of appreciation of its importance by many; for we find some spending several hundreds of pounds on a water-softening appliance, whilst others consider the occasional surfeiting of the boilers with anti-incrustation fluid of unknown composition all that is necessary. In most large installations a water softener is installed, but the cost of maintenance considerably reduces the economies it effects, and for every one of these there are 10 where soda solution or boiler compositions, costing several shillings per gallon, are either thrown into the feed tank without any regard to the varying composition and quantity required under different conditions, or else are not used at all. Where an excessive quantity is used expensive materials are wasted, and fittings injured by corrosion.

In some cases a small pump, actuated by the feed pump, is used to add the required proportion of reagent, but this method has not proved satisfactory owing to the difficulty of keeping the small valves in order and the plunger tight.

A considerable improvement on the pump is a simple piece of apparatus manufactured by Messrs. Kennedy, of Kilmarnock, and shown in the accompanying sketch.



It consists of a mushroom valve, B, which is periodically opened by a cam or tappit on the feed pump or water meter, allowing the reagent in the tank T to flow by gravity into the suction pipe of the pump, the quantity admitted being regulated by the float A, enclosed in a glass tube which it fits loosely.

The action is as follows:—When the valve B opens, the liquid in the tank flows through the controller carrying the float A with it until it reaches its seat, E, stopping the flow. When the valve B again closes, the float A returns to the adjustable stop C, and is ready for the next delivery.

By raising or lowering the stop C, the quantity delivered can be regulated to any proportion, which is maintained in spite of the rate of delivery of feed water varying. The movements of the float A indicate whether the apparatus is working properly or not.

The simplicity and small cost of this arrangement should recommend it to users of water softening reagents.

THE GLASGOW ELECTRICAL TRAMWAYS CONTRACT.

To repair an error is always difficult, yet we hope that Glasgow will find means to come to a satisfactory conclusion on the engine business. What is done cannot be undone. It is recorded that when a child had been receiving religious instruction she was so impressed as to inquire whether, having gone upstairs and come down again, it lay within the capacity of omnipotence to make it so that she had not been upstairs. So with Glasgow.

However, they have attempted a solution by awarding two

engines to the Allis Company at £28,000 each, and two to Musgrave's at £24,000, the extra £4,000 amounting practically to a bonus for about three months better despatch. This at least was the committee's resolve to recommend to the Council, although Bailie Thomson wished to award all four engines to Musgrave's, whose price was £95,516, against the Allis Company's price for £114,564. This motion was carried, subject to delivery, but Mr. Musgrave could not agree to the delivery terms. What surprises us is that some firm of marine engineers could not see their way to tender for these engines in the time required. What we consider should have been done was to have carried out the promise to have given freedom to contractors, and, at most, to have specified speed, diameter of cylinders, and stroke. Then, and then only, would there have been any semblance of equality. The position was a difficult one, but maintenance for 12 months would have been a safeguard against insufficient strengths.

Writing to the *Engineer*, Mr. H. Austen disallows the Allis Company's right to complain as they are doing, seeing that they put in at the top price, and under the rule practically controlling public tenders, had no chance of success at the price. They were properly disqualified by price, and ought to keep quiet, for they had no right whatever to expect to take the order from other firms who could and would supply fully equal engines at a less price. As regards the question of time for delivery, it is very largely the fault of such municipalities as Glasgow and others uninformed and hesitating, that electrical work has been kept back so much in England, and it is only right that manufacturing engineers should be allowed longer time. They would not have needed such time if the natural growth of the electrical industry had been allowed free play. Municipalities accept goods from abroad made under free labour conditions—in America there is no Truck Act—and entirely unhampered by specification, whereas an English firm is asked to rigidly observe an often impossible specification, and to pay certain wages called "standard," as to which there is no limit of meaning. This demand for a standard wage is simply a means of offence. It enables any Common Councilman to render himself obnoxious to the contractor, and it should be abolished. There is no justification for this clause in any contract on which foreigners have been also allowed to bid.

Turning now to the electrical equipment, we have a different story to tell. The specifications for this portion of the plant strike us as being excellent in every way, and just what was required. They are perfectly fair to any manufacturer who is able to turn out high-class and absolutely modern machinery of large size, and at the same time the buyer is fully protected.

We think with regard to the generators and rotaries that no English firm has any idea as to what must be done in order to build machines of this size to fulfil guarantees such as in the present case—as to delivery they would certainly be out of it.

Moreover, after carefully studying the specifications, in order to see as well as we can what was passing in Mr. Parshall's mind, we have no doubt but that Glasgow has done the best thing in retaining him as electrical expert, even when taking into consideration all that has been said on the engine side of the question, for we do not think that any English engineer has had sufficient experience to do what Mr. Parshall has done. The system is undoubtedly right, his ideas are very clear, and it is easy to see that he knows exactly what he is about.

Our further impressions on technical grounds may be gathered from the following notes on the Glasgow tramway specifications for (1) generators, (2) transformers, and (3) rotaries.

1. With regard to the specification for three-phase generators, we are unable to see that a better or fairer specification could be drawn up. It asks for nothing out of the common, and could be tendered for by half-a-dozen first-class firms.* The temperature rise is fairly liberal, but is it the common figure obtained with all such large units? The same remark applies to the fall of pressure allowed and to the efficiencies at various loads. Machines built on the lines indicated (which, as stated before, are practically the constructional lines adopted by first-class firms on the Continent and in the States) would come out reasonably light and cheap, while amply good enough electrically, and the buyer would have thoroughly reliable machinery.

The tests specified are reasonable, but perhaps would add somewhat considerably to the contractor's price on account of the size of the units. They are, however, none too stringent. With regard to delivery, the times allowed are very short, and no firm could deliver anywhere near the time stated unless they had already made similar machines, that is, unless they had the whole design and patterns complete.

As to whether any English firm could supply these machines, we are decidedly of opinion that there is not a firm in the country who could do so. Nothing of this size has been attempted up to the present by any firm here (alternators of the "ironless core" type are completely shut out, as being impossible), and they would not have the experience. That is to say, English firms could not guarantee the performance, owing to the want of experience in three-phase machinery of such an output and speed, and they could not deliver in anything like the time, as no English works are equipped to take this size and class of work.

2. *Transformers.*—Here, again, it is difficult to see where the specification could be improved on. The figures allowed for heating, drop, &c., are standard with any good maker of transformers, English or foreign, and are by no means outside commercial limits.

Any English firm having experience in transformer building could give the necessary guarantees easily but we do not think the delivery could be made so quickly as asked for.

The question here—England *v.* Abroad—would turn solely, we imagine, on the price and delivery.

The tests are reasonable and sufficient. The moderate heating asked for could not be attained without oil-cooling or air-blast, unless the transformers were made very heavy and expensive.

Nothing is said about protecting the high pressure terminals or their position.

3. *Rotaries.*—Nothing out of the way is asked for, and the guarantees, tests, &c., are by no means too stringent.

Efficiency and heating figures are quite normal.

Overload capacity (with fixed brushes) is rather high. The speed is left to the maker.

There is only one point about this specification that would appear to be rather vague, as follows:—The generators, transformers, and rotaries are all specified for on the basis that the load is *non-inductive*. In order that this may be so, it is clear that the rotaries are intended to be *over-excited* in order to get rid of the lag. The amount of over-excitation will naturally affect the clause dealing with parallel running. We think further details might have been given in order that tenderers could see exactly how the machines will be used. The compounding question is also affected by this over-exciting and parallel running. For instance, suppose a big load is put on—the series coils strengthen the field, and hence diminish the lag. This might affect the parallel running if the engines varied much more than the specified amount in the angular speed during a revolution.

These points, however, are perhaps covered by the "choking-coil" clause, which practically gives a free hand to the contractor as to what special devices he may employ in order to get the desired result.

Electrical Extraction of Iron from Ore.—The *Financial News* says that it is reported from Vienna that the Prague Iron Industry Company has commenced a series of experiments with a view to testing the commercial practicability of a new process which has just been discovered for the extraction of iron from its ores by means of electricity. "The idea of replacing the blast furnace by some form of electric furnace is not a new one, as is shown by the trials made in this direction in Germany in recent years, but it is considered that past failures do not preclude the possibility of the new process being tested at Prague proving a financial success and of great benefit to the iron trade in general."

* Other than English.

THE REPORT OF THE PACIFIC CABLE COMMITTEE.

(*Concluded from page* 268.)

According to the estimates made by Sir Sandford Fleming, founded on a very moderate treatment of the continuously-increasing receipts accruing to the existing companies for the 20 years preceding the date of his calculations, we find that he has taken 1898 as the first full year that the cable could be in operation, and that the gross earnings, reckoned at the low rate of 2s. per word for the Pacific cable, would amount to £110,000; for the year 1899, £126,500; and for the year 1900, £143,000. If from these estimated yearly earnings we deduct in each case the fixed charge for interest and working expenses of £75,000, we would have a surplus in 1898 of £35,000, in 1899 of £51,500, in 1900 of £68,000, showing a total surplus of £154,000 for the first three years the cable would be in operation. After these first three years, during which the cost of maintenance would fall on the contractors, this item would be a charge against surplus earnings. Sir Sandford Fleming has taken the annual cost of repairs and maintenance, interest, and working expenses, at £125,000, and allowing for this he finds that the total surplus in 10 years would amount to £742,000 on the assumption that the volume of traffic would increase at the normal rate. The low rate of interest payable on capital, owing to the guarantee of the British Government, is an important feature in these estimates. Apart from the figures given above, Sir Sandford Fleming directs attention to an advantage frequently overlooked, and to which the Committee make no reference in their report, viz., that the reduction of rates from 4s. 9d. to 3s. per word will, within the first year after the Pacific cable brings such reduction about, effect a gross saving in Australasia and the mother country of £190,000, a saving which will be repeated annually, and will be continually augmented by the growth of business. The indirect advantage to Canada will be great, and as the Pacific cable is now receiving the support of the Home Government, and absolute cash returns do not count for everything in the matter, we may well consider the indirect gain to the Dominion as not the least of the prospective profits. Miss Flora Shaw has pointed out that "Canada commands the commercial high road of two hemispheres," and the establishment of the Pacific cable is a necessary adjunct to this highway, all the more advantageous that, in itself, it will be self-supporting, if not a source of profit.

In their report the Committee are careful to state that they have been "actuated by extreme caution," and although we think that as regards the probable revenue the report is too conservative, still we are glad to see that here, as in other divisions of the report, the Committee have refused to accept, blindfold, the opinions and figures advanced by the representatives of the Eastern Extension Telegraph Company and other declared opponents to the Pacific cable, and this even, although the officials of the English Post Office have, in almost every instance, been more or less in agreement with those who have vainly sought to quash the project. In his report to the Canadian House of Commons, Sir Sandford Fleming has written very strongly concerning what appears to him to be an extraordinary unanimity of opposition; but we do not propose here to go further into this aspect of the matter. We have been contented to deal with figures and statements as we find them given in evidence, and our readers, like Lord Selborne's Committee, may find much interest in the process by which the figures and opinions of some of the witnesses have finally been arrived at.

VI.—If the Cable were to be National Property, what would be the Proper Method of Management and Administration?

We are quite in agreement with the report of the Committee on this head—that the general direction should be under the control of a small board, on which the associated Governments would be represented. It is true that, to avoid the petty jealousies which have frequently arisen in the past amongst the Australasian Colonies, it might be necessary to have a larger board than that which would be absolutely necessary for fair representation of the various parties to the Pacific cable scheme. But as the interest is a common one, we do not anticipate that much difficulty or delay would be caused by a very full representation. We are, however, clearly of opinion that it would be a most regrettable mistake to place on such a board any of these gentlemen who have shown themselves adverse to the laying of the Pacific cable. In the establishment and management of this work neither pessimism nor incompetence should have a part. These are not the qualities which are required to establish a satisfactory position in the face of powerful opponents.

VII.—What should be the Form of Contract offered to a Contractor for its Construction?

The Committee only touches lightly on this point, which, in view of the variety of opinion expressed in the technical evidence, is of some importance. We think that, as this is a subject connected with long deep-sea cables which have not as yet come under the control and experience of the Post Office authorities, it would be best that the Board of Management should nominate three representative cable engineers, professionally independent of each other, and unconnected with any manufacturing company. The engineers thus selected to draw up and submit to the Board of Management such specifications and terms of contract as they may agree upon; this draft form of contract should then be sent to each of the manufacturing firms, who should return the draft to the Board with such notes or suggestions as they may think necessary. The final form of contract on which tenders would be invited from manufacturers could then be decided on by the Board in consultation with their engineers. By this means the Board would have the advantage of finding before it the fullest information on the subject to be decided upon, as well as the opinions of all those most competent to deal with the matter. We are perfectly aware that this is not the usual procedure, but it appears to us the method from which the best results may be derived.

We have now dealt with all the points mentioned in the instrument of appointment of the Committee, but in the course of the evidence a considerable amount of attention was drawn to the question of duplication, a question which goes hand in hand with that of the durability of cables. Lord Tweeddale raised the question as to the need of duplicating cables, and in answer to a question (No. 1,968) says that duplication is a principle on which his companies have acted, and, again, in reply to question No. 2,107 *et seq.* says that duplication is an absolute necessity for safety. Sir W. H. Preece cannot call to mind "a single instance in which reliance has been placed in a single cable." There is no doubt that there would be an additional load on the Pacific cable cost were only the above opinions correct! But elsewhere in the evidence these opinions are not supported. Lord Tweeddale himself makes reference to the company's cable from Madras to Penang, but appears to forget that this main line cable to Australia and the Far East, laid in 1870, remained unduplicated for 21 years, also that his second Penang-Singapore cable was laid 22 years after the first, further, that nine years elapsed before the laying of the second cable from Java to Port Darwin, thus duplicating the only connecting link with Australia; again, that his company did not lay a duplicate cable from Australia to New Zealand until the first one had been working for 14 years, and finally, that the solitary cable which was laid between Singapore and Banjoewangi 20 years ago, and which is the only submarine cable link now connecting Australia with Singapore and the rest of the world, is only duplicated by the use of the Dutch landlines through Java. Thus, in the history of the Eastern Extension, &c., Company alone there is to be found an object lesson on the need for immediate duplication of cables! There are numerous other similar instances which may well have escaped the attention of Sir W. H. Preece, but which should have been well within the knowledge of the representatives of the Eastern Extension, &c., Company. We could cite many instances in support of our opinion that the durability of well designed cables, laid after a careful survey has been made, is much underrated, owing to the shortness of the life of many ill-designed lines, but space will not permit us to enter on this. The Committee advise the laying of a duplicate cable, which they think would be advantageous, although not an immediate necessity.

There are many points of minor interest on which we might enlarge, but it is sufficient that the principal considera-

tions have been laid before the readers of the Review, fairly and impartially, we believe. We cannot leave this subject without an expression of hope that the Pacific cable project, now on the verge of accomplishment, and which we have consistently and continuously advocated ever since its inception, may be successfully achieved, and we also hope that in time even those who have not strenuously opposed it, may agree with us in the opinion that the establishment of such a cable is of the greatest importance to the progress and unity of our empire.

FLY-WHEEL POWER OF MOTORS.

By E. K. SCOTT.

In driving certain types of machines individually by electric power, the question of fly-wheel effort comes prominently forward. As usually made, the fly-wheel power of small electric motors is very low, and if they are coupled up to machines which have been previously driven by a long line of shafting crowded with wheels, pulleys, belts, &c., it may be found that the change is not quite satisfactory.

A class of machines in which this is important are the "doughers" and "breakers" used in biscuit making. These machines have heavy rolls requiring to be constantly reversed, and very considerable effort is required each time the dough enters the rollers. To buy an ordinary motor and reversing switch off the shelf, as it were, and connect it up by gearing to such machinery without any thought as to the fly-wheel power, &c., is risking a failure.

Planing machines present a somewhat similar problem, and it has been found best to drive them by a motor constantly running in one direction and arranged with some amount of fly-wheel power.

Pulping machines, used in paper making, also require motors with a good deal of fly-wheel effort in order to keep up the speed when any knotty material enters the roller teeth.*

Some machines, such as shears, punching machines, stone breakers, &c., are themselves fitted with heavy fly-wheels, and as no reversal of the motor is required, they can be driven in a fairly satisfactory manner by a stock size machine dropped down alongside. On the other hand, the coupling up of a motor to a set of Callender rolls, which need extremely slow and steady variations of speed as well as reversal of the direction of rotation, requires some little thinking out.

The writer might go on giving particulars of special cases, but it will be seen from the above that although there is nothing *very* complicated about it, some little thought and judgment is required in applying electricity to driving machines.

Motors as at present made, and especially the smaller sizes, ½, 1, 1½, 2, 3, and 4 H.P., are certainly lacking in weight of the rotating parts. The tendency all along has been to cut down the size of the armature, &c., to the smallest possible dimensions. One often sees a heavy fly-wheel fitted on a machine having a ridiculously small armature. Surely it would have been better and cheaper to have put the weight into the armature, &c., right away. Any motor, whatever it is required for, is all the better for having plenty of fly-wheel effort.

This need of weight in the armatures, &c., of small motors raises anew the suggestion of using iron wire for the conductors. At the present moment the problem stands somewhat as follows:—Individual motor-driving is acknowledged to be the correct method of applying electric power to machinery; for instance, instead of one 20-H.P. motor driving a group of 10 machines, there should be 10 motors each of 2 H.P. Now, the majority of machines are comparatively slow running, and one or two trains of gear wheels are required from the motor spindle. Gearing does not work altogether satisfactorily at high speeds; besides, the less there is, the more efficient the combination. The tendency is, therefore, to follow traction practice and have slow speed motors with only a single reduction gear.

Now it happens that the most convenient way to get slow speed is to have four poles instead of two, and as the usual voltage is 220 or 440, the sizes of the armature conductors come out excessively small. A 2-H.P. 220-volt four-pole motor, for example, only requires about 8 amperes at its terminals, giving, say, 2 amperes through the armature conductors, whilst a 440-volt motor will actually have only 1 ampere flowing through the armature conductors. It will readily be seen that to wind an armature with the theoretical size wire for such trifling currents, is both difficult and expensive. As a matter of fact, No. 18 S.W.G. wire is really the smallest size which is mechanically safe, and this has an area many times larger than what is really required. Substituting iron wire at once gets over this mechanical difficulty, because, for equal conductivity, the wire is about two and a half times the diameter of copper wire.

There is another advantage in using iron wire. Small motors are principally uneconomical because the armature winding with its insulation, binding, &c., occupies such a relatively large amount of space; in other words, the air gap, and therefore the exciting walls, are excessive. Iron conductors being also magnetic get over this difficulty in a delightfully simple way, and the reduction of the air-gaps to a mere mechanical clearance carries with it the further advantage that the pole covers may be brought much nearer together without undue magnetic leakage, thus rendering a larger proportion of the armature circumference useful.

As the area of iron wire is six times the area of copper, there is, of course, more space taken up, and the total weight of the revolving mass is considerably heavier, but as has been pointed out above, this is a distinct advantage for motor work.

Fly-wheel power is what the small motor, as at present made, sadly lacks.

The question of cost comes secondary to turning out a satisfactory machine, but in this also the iron would probably score for voltages of 220 and upwards. For one thing, the cotton covering would be cheaper, and the wire much easier to handle, which, seeing that the cost of small machines mostly goes in labour, is a consideration.

Those who have not thought over the matter may be inclined to scoff at the idea of using iron wire conductors, but there is undoubtedly much to be said in favour of the change for motors of less than 3 or 4 H.P. at 220 and especially 440 volts. This latter pressure is likely to be much used in the future, but as matters stand at present it is practically impossible to build the smaller motors for this pressure.

* It is interesting to note that as the top roller takes the power, and is, at the same time, always on the rise and fall, according to the condition of the material passing through the rollers, the problem presented by the gearing is practically the same as that of a tramcar motor.

LIMITED ELECTRIC STATIONS.*

By ALTON D. ADAMS.

A central station of low first cost and high operative efficiency, to serve a limited area, is a common problem in electrical design. Hundreds and thousands of small cities and towns have nearly their entire business interests within a radius of one-half mile from a central point, and the possible demand for electric light and power is such as to warrant only a very moderate outlay. When the fact that very small central stations, in places similar to the above, run at a loss is held in mind, the necessity for careful selection of equipment is evident, and the designing engineer must decide a variety of questions with no little skill, to insure a financially successful plant.

The station under consideration would be required to operate from 18 to 24 hours per day, and this fact has an important bearing on the average efficiency of electrical equipment, when it is considered that the maximum load of lamps on a central station usually continues but two or three hours per day, and the load during the remainder of each

* *American Electrician.*

day is but a small part of the maximum amount, since the variation of losses inside and out of the station does not necessarily rise and fall in the same ratio as the load.

There are two main classes of electric generators, either of which may be used to operate incandescent lamps, namely, those generators intended to connect directly with the lamps, through the proper conductors, and those intended to connect with transformers, but having no electrical connection with the lamps. Generators connected directly with the lamps are limited in electric pressure or volts to the voltage of the lamps, plus the small loss of pressure allowed in the connecting wires. Generators for connection to transformers are of the alternating current type, and may be of any desired voltage, as the proper voltage for lamps is supplied by a suitable transformer.

Alternating current generators with transformers have been much more frequently selected for stations like the above than have the type of generators suitable for direct connection to the lamps, for two reasons—first, because the weight of conductors to supply a given number of lamps at a fixed distance and per cent. of loss varies universely as the square of the volts or electric pressure at which the energy is supplied; and, secondly, because until several years ago the highest practical electric pressure at which lamps could regularly be had was about 110 volts. At 110 volts the weight and cost of conductors is very large compared with other parts of the equipment, even on distances so short as one-half mile; while a voltage may readily be selected for alternating current generators at 1,000 or 2,000 volts, which will reduce the weight and cost of conductors to a very low figure.

The great saving in conductors made possible by the transformer system at 1,000 volts as compared with the 110-volt system is shown by the ratio $(110)^2 \div (1{,}000)^2 = 0{\cdot}0121$ in weights of conductors for the 1,000-volt system, compared with the weights for the 110-volt system.

A third method of distribution, known as the three-wire system, by which the station voltage could be increased to from 220 to 250 volts, with 110-volt lamps, has also been possible, but being patented its use has been mostly limited to stations buying their electrical machinery of a certain company. Considering at first what are called the outside wires of the three-wire system, the weights of conductors required for it, compared with those of the 1,000-volt transformer system are shown by the ration $(1{,}000)^2 \div (250)^2 = 16$, that is, sixteen times the weight of conductors is required for the two outside wires of the three-wire system as for the 1,000-volt system; but the third or neutral wire of the three-wire system is usually made of the same size as each of the other two, so that the total weight of conductors for the system becomes $16 \times 1{\cdot}5 = 24$ times the weight necessary for the 1,000-volt system.

The 125-volt system, connecting dynamos directly with lamps, has been used in a few small stations, serving very limited areas; the 250-volt three-wire system has been very largely used by stations buying their electrical machinery from a certain company, and its use would have been much more extensive were it not for the patent limitations above named.

Reasons for the continued use of the three-wire system in many cases, and of the 125-volt system in a few stations serving a very small area, are found in the cost of transformers, which must be added to that of conductors for the 1,000-volt alternating system, and in the low all day efficiency of the transformer system.

The low all day efficiency of transformers is due to the fact that a large part of the loss in a transformer remains constant, so long as it is connected to the supply of current, no matter how small its load of lamps, or whether it is operating any lamps at all.

Now, as even quite small central stations must operate from 18 to 24 hours per day, and as most of the transformers have only a very light load or no load during most of the time, the constant transformer losses materially reduce the average efficiency. In spite of the cost of transformers and their low average efficiency under working conditions, the transformer system seemed destined to do the great bulk of incandescent lighting from small and medium central stations, had the maximum practical pressure for incandescent lamps remained at about 110 volts, but happily this is not the case.

For several years back incandescent lamps for from 220 to 240 volts pressure have been regularly on the market, and their advent, marking a new era in central station design, necessitates reconsideration of the advantages of direct and transformer systems of incandescent lighting. Allowing a moderate pressure for the loss in conductors, the new high volt lamp permits the same station pressure as the three-wire system—that is, about 250 volts—and therefore requires the same relative amount of conductors, compared with the 1,000-volt transformer systems, as is necessary for the two outside wires of the three-wire system, which amount, as computed above, is 16 times that at 1,000 volts. It is evident from the above that a fair decision between the merits of a transformer and a direct system for any given case, must rest largely on the relation between the sum of costs for conductors and transformers for an alternating system, and of conductors alone for a system of direct connection from dynamos to lamps, and also on the operative efficiencies of the two systems. The cost of conductors for the 220-volt lamp is to the cost of conductors for the 110-volt lamp on the two-wire system as $(110)^2 \div (220)^2 = \frac{1}{4}$; that is, but one-quarter of the weight in conductors is required, and as the three-wire system makes necessary a third wire, equal in weight to each of the other two, the 250-volt two-wire system requires only two-thirds the weight of conductors necessary for the three-wire system, with 110-volt lamps.

To determine, therefore, the best system under the usual circumstances, and free from chances of patent litigation, comparison should be made between the 250-volt two-wire and the 1,000-volt or 2,000-volt transformer system.

For purposes of comparison, the cost of electric generators for a given capacity may be taken as the same for either system, though the price of low pressure generators for the direct work would usually be somewhat lower than those of high pressure for use with transformers. To reach a correct decision as to the merits of heavy conductors alone on one side, and light weight conductors plus transformers on the other, each transmission system should be designed to operate at the same average efficiency during the entire daily run, or at least at some definite efficiency, so that due allowance may be made for difference in efficiencies if any exists. In places of moderate size, the average capacity of transformers which can economically be used is quite small, as individual users usually require but few lamps, and if more than two or three consumers are supplied from the same transformer, the cost of the low pressure wires to lamps becomes too great.

In a plant of moderate size, using transformers, lamps may be assumed to be divided equally between those of 40, 60 and 100 lamps capacity of 16 nominal candle-power each, and the all day efficiencies of these transformers may be fairly taken at 84, 86 and 88 per cent. respectively.

The average all day efficiencies of above transformers will therefore be $(84 + 86 + 88) \div 3 = 86$ per cent. of the energy delivered to them.

Consider now the cost of conductors on the 220-volt lamp system, and of conductors and transformers on the 1,000-volt alternating system to supply 1,000 16-C P. lamps, taking 55 watts each and grouped at 2,500 feet from the station.

The maximum loss in conductors for the direct system at full load may be taken at 14 per cent., or the same as the average all day loss of transformers, although the maximum loss will result in a much lower average loss. With a loss of 14 per cent. in conductors and 220 volts at the lamps, the volts at the dynamos must be $220 \div 86 = 255{\cdot}8$ and the pressure expended in conductors $255{\cdot}8 - 220 = 35{\cdot}8$ volts. 1,000 55-watt lamps consume 55,000 watts, and at 220 volts the amperes must be $55{,}000 \div 220 = 250$.

The area of copper conductors to transmit 250 amperes through 5,000 feet of its length with a drop in pressure of 35·8 volts, taking 11 ohms as resistance of a mil-foot of copper, is found by the formula for circular mils as follows:—

$$C\,M = \frac{11 \times 250 \times 2{,}500 \times 2}{35{\cdot}8}$$

Therefore, circular mils = 384,070. The weight of a 384,070 circular mil conductor, insulated, and 5,000 feet long, is about $1{,}308 \times 5 = 6{,}540$ lbs., the weight being about 1,308 lbs. per 1,000 feet, and its cost, at 20 cents per lb. is $6{,}540 \times {\cdot}20 = \$1{,}308.00$.

Coming now to the alternating system with transformers,

E

the average cost of small transformers may be fairly taken at $1.25 per lamp capacity, so that their total cost for 1,000 lamp capacity is 1,000 × 1.25 = $1,250.00.

As the average efficiency of transformers for all-day service is quite low—86 per cent. in this case—it is desirable to maintain a very high efficiency of conductors in the alternating system, so that the total efficiency of transmission may be as high as practicable. Were there no loss whatever in the conductors between alternating generators and transformers, the efficiency of the system would be lower than that of the direct system on the loss assumed in the direct conductors, since while this loss was taken at its maximum as equal to the average loss in transformers, its average amount will be much below the maximum, and therefore below the average loss in transformers.

It should therefore be noted that while in alternating current transmission with transformers the highest efficiency is at full load, and efficiency drops as load decreases, just as the opposite of this is true for the direct system of transmission, in which the lowest efficiency of conductors is at full load, and the efficiency rises as the load decreases.

In consideration of above facts the loss in alternating current conductors for above case may be taken at 2 per cent. for full load, and be less than this at average load.

As 1,000 55-watt lamps consume 55,000 watts when all lighted, the watts then delivered to transformers, taking their average full load efficiency at 95 per cent., will be 55,000 ÷ 95 = 57,893 watts. To transmit this power over 5,000 feet of conductors at a loss in them of 2 per cent. and 1,000 effective volts at transformer terminals requires about 2,900 lbs. of insulated conductors, which at 20 cents per lb. cost 2,900 × ·20 = $580.00. Adding the cost of transformers found above at $1,250 and the $580. just found for conductors between generators and transformers gives a total of $1,830.00, but this does not include any charge for conductors to connect transformers with the lamps on consumers' premises.

With 100-volt lamps a loss of 2 per cent. in wires to transformers, and an average length of 200 feet for these wires, the 55,000 watts consumed by all the lamps require for their transmission about 426 lbs. of insulated conductor, which, at 20 cents per lb., amounts to $85.32, making, with the $1,830 above, a total of $1,915 for the alternating current transmission system.

The cost of transmission system for the direct current in above case was found to be $1,308, so that the alternating system costs 1,915 ÷ 1,308 = 1·46 times the direct system of transmission under the fair assumptions above, for a concentrated load at one-half mile from the station. Had the direct system of transmission been designed for the same average efficiency as the alternating, its cost for conductors would have been much less than the $1,308 above found, and the increased cost of alternating system over the direct would therefore have been much greater.

Having noted, however, the increased cost of the alternating system for what may be considered ordinary design in each case, it will now be interesting to compare the efficiency of the two systems. The average efficiency of the transformers in above case is 86 per cent., and for the average loss in the two sets of alternating current conductors, with 2 per cent. loss in each at maximum load, about 2 per cent. should be allowed as average loss, making the total transmission efficiency of the system about 83 per cent. on the average.

The loss in conductors of the direct system varies directly as the load on them, and will therefore be 14 per cent. at full load, 7 per cent. at half load, and 3·5 per cent. at one-quarter load, and 1·75 per cent. at one-eighth load, of the energy transmitted at each stage of load. It is a fair assumption that full load will last during two-tenths, half load during two-tenths, quarter load during two-tenths, and eighth load during five-tenths of the time, in which case the total transmitted energy conveyed at each stage of load may be taken as follows:—At full load, 1 × ·2 = ·2; at half load, ·5 × ·2 = ·1; at one-quarter load, ·25 × ·2 = ·05; at eighth load, ·125 × ·4 = ·05; the sum of which is ·2 × ·1 + ·05 + ·05 = ·4.

The part of total energy transmitted at each stage of load will therefore be, for full load, ·2 ÷ ·4 = ·5; for half load, ·1 ÷ ·4 = ·25; for quarter load, ·05 ÷ ·4 = ·125; and for eighth load, ·05 ÷ ·4 = ·125.

Applying per cents. of loss for the several stages of load, the per cents. of total energy lost at each stage of load are: Full load, ·5 × ·14 = ·07; half load, ·25 × ·07 = ·0175; quarter load, ·125 × ·035 = ·0043; and eighth load, ·125 × ·175 = ·00218. The sum of these fractions of total energy is ·094, or 9·4 per cent., so that the average transmission efficiency of the direct system is 90 6 per cent. For above case, then, the cost of transmission devices is not only 1·46 times as great with the alternating as with the direct system, but the average transmission loss with the alternating system is 17 ÷ 9 4 = 1·8 times that with the direct.

The facts illustrated by the above figures seem ample to warrant the growing preference for direct electric distribution over moderate areas.

CORRESPONDENCE.

Renewable Lamp Company.

I have read your remarks in your issue dated August 20th, in which you state that "we are afraid we cannot congratulate the Renewable Lamp Company on the lines adopted by their advocates."

I have not the slightest knowledge of anybody who has taken it upon themselves to write letters on this question, and I must disclaim any association with them whatever, and with their discussion.

I have no intention of discussing this matter in the public press, considering that it is quite unnecessary; but for your information and for that of your readers, I may tell you that the works are being equipped in Shoreditch on a large scale, the various appointments of officials have been made, contracts are also being entered into with local authorities, railway companies, theatres, hotels and clubs, &c., and you may rest assured that the activity being thrown into this matter will make it such a live concern that there will be obviously no need for any discussion.

If you will kindly let the question rest, it is a very short time to seeing the lamp thoroughly and practically demonstrated and in general use, which is better than all anticipated discussion.

J. Atherton,
per E. T.

Prescot, Lancashire.
September 4th.

"The Value of Electrical Treatment."

My attention has been drawn to a review of the above work which has recently appeared in your columns, and I wish to protest, in the strongest manner, against the tone in which that article is written. Fair criticism must be welcome to every sensible man; but mud-throwing should not be allowed in the pages of a professional journal. Your reviewer, however, has thrown mud, by comparing me with a notorious quack and imposter.

Allow me to say that the conclusions at which I have arrived concerning the medical uses of electricity, and to which your reviewer has taken exception, are the outcome of upwards of 40 years' extensive special experience, both in hospital and private practice. They are no phantasmagoria, but have been forced upon me by what I have observed clinically over and over again, and year after year, and they may be verified by anyone who will take the trouble of working conscientiously at this subject. That portion of my work which relates to the use of electricity as a general nervine tonic, and its effects in reducing or removing the infirmities of old age, and which seems to have excited the special ire of your reviewer, has been favourably received by the greatest authorities abroad, such as Prof. E. Von Leyden, of the University of Berlin, Messrs. Trijier & Apostoli, of Paris; Prof. Domner, of the University of Lille, and many others; and has excited the greatest interest and attention in all parts of Europe and America. It is in consequence of it that I have been requested by the committee of the forthcoming International Congress of Electro-therapeutists, which will be held in

Paris, in July, 1900, and which is being organised by the Société Française d' Electrothérapie, to give an address on the medical use of galvanism and faradism, and to open the discussion on it on that occasion. This shows as well as anything could, that those best qualified to judge, respect my teaching on that subject.

I feel convinced that my therapeutical discoveries, although they may appear startling to those unacquainted with the matter, will in 10 or 20 years' time be utilised by the entire medical profession, as a mere matter of course. An author on a special subject, who is in advance of his time, must occasionally pay the penalty for this, by receiving obloquy instead of praise; but I confess that I was not prepared, after such a long professional record as I lay claim to, for an onslaught which I consider most spiteful, if not actually libellous, and of which I trust and believe that he who has made it, will, on reflection, be heartily ashamed.

I request that you will insert this disclaimer in your next impression, and am,

Julius Althaus, M.D.

Hof Ragatz, Switzerland,
September 2nd.

Stresses in Steam Engines for Electric Traction.

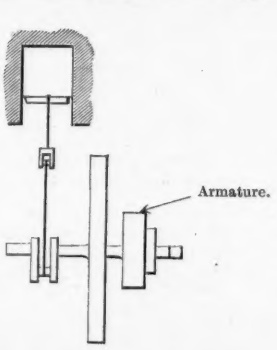
The able article on this subject in your issue of yesterday will serve as an incentive to thrash this matter out rather more fully than has, so far as I am aware, been done at present. It is, however, rather unfortunate that, after maintaining his case so well as regards the stresses on the crank-shaft on the *engine* side of the fly-wheel, you contributor should, as it were, at the last moment, rather give himself away by the manner in which he tackles the stresses arising on the *dynamo* side of the fly-wheel.

What I take exception to—and I do so very reluctantly, as I would much prefer to accept the solution of your contributor—is the statement that: "a traction generator has no mechanical or material inertia to overcome when a sudden accession of load is put upon it, and *this fact limits the maximum possible stress in the shaft to double the ordinary.*"

May I suggest to your contributor that it is *not* this fact which limits the possible stress, but, as I shall hope to show, simply and solely the question of the time-lag of the generator and the rapidity of action of the automatic cut-outs in the station.

Leaving for the moment, however, the question of the cut-outs, your contributor seems to have forgotten his remark, made earlier in his article, in which he acknowledged that there *were* "resistances due to the revolution of an armature in a medium resembling a fluid with a variable viscosity."

The point at issue is this: Is it not conceivable that the drag exercised by the field on the periphery of the armature (and which may be likened to the sudden application of an



extremely powerful brake) may, under certain conditions, attain proportions so considerable as to entirely outweigh questions of the inertia of the armature?

For clearness sake let me again repeat that I am now only considering the stresses on the shaft connecting the armature with the fly-wheel, and *not* those on the engine side of the fly-wheel.

This being so, what are the conditions? The fly-wheel and the armature are running at the normal speed; a short circuit occurs on the line; a rush of current of perhaps several thousands per cent. above the normal current (due to 500 volts acting through a trifling resistance); a sudden increase of the retarding armature torque, amounting—even assuming the field remained unaltered—to, in all probability, at least *one thousand per cent.* above the normal.

The result is equivalent to the sudden application to the armature of an immensely powerful brake, while the fly-wheel goes merrily on its way.

Your contributor, however, ignores this action. All I can say is that, though I have perhaps overstated my case as regards quantities, yet I can adduce from personal knowledge an instance where *two* traction dynamos, designed to absorb approximately 200 B.H.P. apiece, had their 5-inch shafts sheared off at the point where one would expect, from the above considerations, that such an accident would occur, and this *within three weeks* of one another.

The third was only saved, if I remember rightly, by reducing the weight of the fly-wheel by turning it down.

I am sorry that, for want of further time, I cannot now go into the question of why everything hangs on the number, arrangement, and rapidity of action of the automatic cut-outs; but the inference is a fairly obvious one, and I will close here, in the hope that I have explained my grounds for differing with your contributor's conclusions.

A. M. Taylor.

The only difference between myself and Mr. Taylor, is one of meanings. By mechanical or material inertia, I mean such inertia as, in a marine engine, is represented by the sudden putting into motion or rapid acceleration of a mass of inert water. The intensity of stress produced by such action is measured by the mass put into motion, and the time occupied in the process. The shorter the time the greater the stress, and given sufficient velocity acquired, and short enough time, a very little weight may induce enormous stresses. Now, the action of a sudden accession of current in a generator, can at its worst only represent a double stress. It is like the application of a brake to a fly-wheel, but it is not like the putting in of a claw-coupling attached to another and stationary fly-wheel. Now if we allow, and Mr. Taylor does apparently allow, this equivalent braking action, the whole question is narrowed down to the pressure that can be put upon the brake lever. I did *not* overlook this action, but merely stated that the stress due to it could not exceed double that due to the maximum current ordinarily generated. By *ordinary*, I mean the current beyond which the circuit breaker will not permit any addition.

If there were no circuit breaker, the braking action might be enormous, but I have assumed circuit breakers without which safeguard I fear stresses would be incalculable, and I should as soon make an engine without a fly-wheel as a traction system without a cut-out, and I have never seen any traction station without circuit breakers. Perhaps if Mr. Taylor will read the article again, assuming cut-outs, he will be in agreement with me. If not, will he state whether there is, or is not, reliance to be placed on circuit breakers. Does he consider these so slow in action that they permit the passage of such severe currents as to render them practically useless. Let me put Mr. Taylor's 1,000 per cent. of torque and my own coefficient of two for sudden loading into practice as follows:—

I will take it that Mr. Parshall's engine has a torque average equal to a 21·4 shaft with a 12-inch hole in it. This is smaller than Mr. Parshall's dimensions point to. Then 1,000 per cent. × 2 = 20 fold as the indicated ratio of strength in the shaft between fly-wheel and generator. The shaft for this must be 54·6 inches diameter!!! with a 12-inch hole, and Mr. Parshall's 32-inch shaft must twist off like lead. It is far too weak. Now, if Mr. Taylor's assumption is probable, as he says it is, it must be clear that Mr. Parshall places an enormous reliance on circuit breakers, so much so as to design or accept shaft diameters only half what they should be. For my own part, I have accepted the circuit breaker as being capable of preventing current in excess of a fixed maximum, and it is this fixed maximum which I would double to allow for sudden application. From his letter, I judge that Mr. Taylor has more to say, and I, for one, would be glad to have him say it. Will he tell us the rapidity of action of a circuit breaker, and

whether it will do what I expect it to do? The whole safety of a traction station hinges on this, and without circuit breakers I fail to see what limit of sizes can be fixed on for a shaft.

Let us first agree on terms. By ordinary stress is meant the limit fixed by circuit breaker; by material inertia the energy of acceleration of a mass. My contention is, that the stress in the generator shaft is limited *within* double this ordinary, just as a beam deflects doubly as much under a suddenly applied load.

Will Mr. Taylor also state, can a short circuit produce an absolutely instantaneous sudden rush of current, or is there a certain duration of time in building up? Why are some circuit breakers fitted with a retarder to prevent them acting from mere passing flushes? These retarders are dangerous, for they prevent rapid action when this is necessary. If it is established that a circuit breaker will prevent excess of current, then there can be no abnormal or incalculable shaft stresses. If, on the other hand, they are not reliable, then Mr. Parshall's heavy shafts are mere temporary spindles.

Finally, Mr. Taylor adduces two cases from personal knowledge, where some 5-inch shafts were twisted off. Will he tell us, first, whether there were any circuit breakers; and, secondly, at what speed these shafts were running, for I find that if they were running at 180 revolutions, they correspond in strength with a solid shaft on a 4,000 H.P. generator at 90 revolutions per minute of 17 inches diameter, and a hollow shaft with a 12-inch hole of less than 19 inches diameter. It looks rather as though these 5-inch shafts were weak to begin with.

The Writer of the Article.

ECONOMY IN USE OF SUPERHEATED STEAM.

Mr. R. S. Hale is well known as a steam engineer in America, and his remarks on superheated steam in the *Engineering Magazine* are entitled to consideration. He anticipates the spread of superheating to England and America. A few years ago the practice seemed to have fairly recommenced in England, but we seem of late to have heard very little on the subject. The methods of superheating are discussed and enumerated. There are three usual methods.

(*a*) To place the superheater in the flue entirely behind the boiler. This effects a small gain and boiler efficiency, but less than can be secured from a flue feed-heater or economiser, but it cannot be very effective in adding a serious degree of superheat, for the waste gases have a temperature nothing much above that of the steam itself, unless when the boiler is forced, when a superheater may be itself effective, and also a considerable aid to the boilers.

(*b*) The superheater may have its own special furnace. Heat so applied is usefully applied, but the separate furnace is difficult of satisfactory application, and the total efficiency for the *production* of steam will be diminished.

(*c*) By placing the superheater in the path of the gases earlier than the waste flue, higher temperature is secured with efficient and considerable superheat. Nothing in the system prevents the application of the economiser at a later point, and generally the system seems to commend itself to Mr. Hale. It will be remembered that this is the system of which a good deal was said a few years ago in connection with the McPhail & Simpson superheater. But Mr. Hale appears only to know the system as applied on the Continent.

He says that carefully kept records show that the net result is equivalent to an addition of so much of the heating surface. 500 feet of superheater surface, he considers, would be equal, say, to 250 feet of more efficient water-cooled heating surface. If we recollect rightly, the experience of the McPhail system appeared to point to very effective surface if the steam was wet. A boiler could be forced until it primed, and the superheater dealt with the priming, and a water-tube boiler could thus be safely pushed to double and even treble its ordinary output, the superheater giving dry steam. Further, this position of superheater gives very even results, and it is fairly safe.

Still, an equal surface in an economiser will do more than a superheater, says Mr. Hale. Here, of course, he is speaking only of the generation of the steam, not of its possibly more efficient use. There are certain losses which are increased by the use of superheated steam, namely, those of radiation and leakage. The radiation losses increased with the superheat. This may be so, and still it is advantageous from a using point of view that steam should arrive dry at an engine. Saturated steam can never arrive dry. Superheated steam may.

Being bulky, superheated steam will suffer a greater fall of pressure than saturated steam because it must travel quicker. But is this quite true. It will travel faster with greater ease, for it will not be retarded by inert particles of water, and the velocity of a current of steam is reduced by its load of water. We quite agree, however, that steam pipes are too big in many cases. A 12-inch main is seen with 6-inch engine branches. Probably better results will be secured by reversing this, and putting 12-inch engine branches from a 6-inch main. A commonly-neglected point in steam pipe designing is that the flow of high pressure steam is very much greater than the flow of low pressure steam. The flow corresponds with the absolute pressure, but the production of a boiler is the same at all pressures. It is the same in weight but the volume differs, and no matter what the pressure the same volume of steam will flow through a given orifice. Obviously, therefore, the steam pipe of a high pressure boiler may be made much smaller than that of low pressure boilers of equal size.

Moreover, with early cut off engines the steam pipe may be correspondingly less than for long admission, provided that the sudden demand of steam at admission be provided for by the use of a receiver close up to the engine. A third loss of steam is leakage, Even when joints appear tight, there may be a good deal of steam leakage going on. Some tests of leakage have given the following figures:—

Mill	5 to 16 per cent.
Electric plant	2½ to 7 „
Steamship	1½ to 10 „
Waterworks	2½ per cent.

Suppose a plant to be worked only half of its capacity, then the leakage percentage will be doubled. As the temperature of superheating varies a good deal, so will the movement of the steam pipes be increased, and this will probably increase this percentage of leakage.

Coming to the engine, however, there is a clear net saving of 20 per cent. down to 10 per cent., and the use of mineral oils seems to have solved the problem of lubrication. Recapitulating, we find:—(1) A slight gain in the boiler; (2) an increased loss in the steam pipes; (3) a large economy in the engine.

While in favour of the form (*c*) of superheater, it is pointed out that where a long distance intervenes between the boiler and engine, the separate furnace may prove superior. Thus, if a short pipe be assumed, the following figures obtain in a typical instance:—

Gain at boiler...	2 per cent
„ „ engine	10 to 20 per cent.
Extra radiation loss	1 „ „
„ leakage „	3 „ „
Fall of pressure „	½ „ „
Net gain	7½ to 17½ „ „

Let now the length of pipes be doubled and the plant be assumed to work at only one-third its capacity.

Gain at boiler	2 per cent.
„ „ engine	10 to 20 per cent.
Extra radiation loss	6 „ „
„ leakage „	18 „ „
„ fall of pressure loss	½ „ „
Net loss, 2½ to 12½.	

In such a case, probably, superheating might pay if done near the engine. It will also pay to equip all boilers with superheaters if it is found to pay when some of them only are fitted.

Mr. Hale's remarks may be carefully considered. They point to the necessity of more careful steam pipe design. Pipe joints are one of the details of high pressure steam practice that are very unsatisfactory. A good steam pipe joint is needed. The lack of one is one of the chief obstructions to the economy of high pressure steam. Yet it seems almost as unattainable as a really strong half-inch bolt.

THE UTILISATION OF WASTE HEAT FROM FLUE GASES.

It is only comparatively recently that American practice has embraced the economiser or flue-feed heater, but having done so American engineers have gone a step further than ourselves, who have used the economiser half a century, for, to an extent unknown here, the system of fan draught has been employed for land boilers, whereas it is almost restricted to marine work in Europe. Yet it is 20 years or more since fan draught was used in a Yorkshire mill, the fans being placed at the rear of the boilers to draw away the products of combustion and discharge them to a chimney which only reached to the roof level of the factory.

The American line steamship pier at New York has its boilers fitted for fan-induced draught, and the plant is described in the *American Electrician*, which premises that with an air temperature of 60° and a chimney temperature of 500, a chimney of 100 feet will produce a sufficient draught, but that a chimney 175 feet will be required to produce the same draught with gases of 250°. This, of course, is just the reverse of a fan which is more effective with low than with high temperatures, and it is where temperatures are low, and in order that they may be low that a fan is used. A fan is more certain than a chimney, for its speed can be regulated to give a desired intensity. Unlike a chimney, and in direct opposition thereto, a fan will probably work better when the barometer is low.

An economiser is not merely an obstruction to the draught, but, by cooling the gases, reduces their draught-producing power, and a limit is put to any desired further temperature reduction. Everything points to the fan in place of the chimney. In a power plant of 1,000 H.P. at least 300 H.P. is rejected at the chimney in ordinary cases, and in good practice 1,000 H.P. at the engines must represent nearly 200 thrown into the chimney. Assume that 100 H.P. can be saved, is it not obvious that the 100 H.P. saved is very much greater

than the power absorbed by a fan. Our contemporary sets down the ratio between fan power and chimney power as 1 : 75.

With gases entering an economiser at 526°, leaving at 269° and heating the feed water from 150° to 297°, a saving of 14·64 per cent. may be effected. Besides feed heaters, there are air heaters which will effect economy, but such things must not be carried too far. Americans in many cases seem to take it for granted that the use of an economiser necessitates a fan draught. This view has not been accepted in England where, for years, economisers have been employed with chimneys of 200 feet in power plants, giving results of 1·75 lbs. of coal per I H P. In America, however, many years since, Mr. Hoadley made tests where chimney gases were reduced to 162°, which represents only about 5 per cent. of heat loss. In Howden's system, the chimney gases are reduced to 574°, and the air supply is raised to 269°, but we suppose there was no economiser in this quoted case. In the particular instance under review, at the steamship pier the fan outlet has a temperature of 456°, and the air is heated to 315° when burning 41·26 lbs. of fuel per square foot of grate surface.

These results, of course, do not compare with those obtained from economisers; these sometimes reduce the gases to 350°, or even as above to below 300°, but possibly the economiser and the air heater could be both employed with advantage. Chimney draught seems never to have been applied with any satisfactory results where the air supply was heated. Something more is needed to force the air in sufficient volume to the fires. Theoretically, a saving is possible, but as air expands with heat its efficacy is spoiled, and it is only since fan draught has been employed that the regenerative system has become practically useful. In the apparatus at the steamboat pier the furnace air is simply drawn through nests of tubes around which pass the wasted gases on their way to the fan. Looked upon merely as a draught producer, the fan is a wasteful implement, unless accompanied by corresponding decrease of waste gas temperature. It should never replace an existing *sufficient* chimney, unless there is at the same time applied some means of using the waste heat. But given such means, a fan may be employed with great economy. So long as the chimney is there it need not be removed. It will always, if big enough in area, help the fan and save power in the fan engine. But if its site is wanted, the chimney may be destroyed, and it may be replaced by a simple low iron stack. It is a good plan to provide ducts, so that the fan may draw its air from the engine room to any desired extent.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Sept 6th, 1898.		Week ending Sept. 5th, 1899.	
Adelaide	Value £2,139	Alexandria	Value £134
Alexandria	18	Amsterdam	25
Bombay	12	Antwerp	40
Bordeaux	10	Auckland	85
Boulogne	100	Bangkok	12
Buenos Ayres	370	Boulogne	63
Calcutta	131	Brisbane	157
Cape Town	957	Buenos Ayres. Teleg. mat. ..	449
Cologne	10	Calais	60
Colombo	14	Calcutta	140
Copenhagen	102	Cape Town	120
Durban	67	Chinde. Teleg. mat.	520
East London	60	Christchurch	50
Gothenburg	119	Christiania. Teleg. wire ..	47
Hong Kong	15	Colombo	53
Lisbon	14	Copenhagen. Teleg. wire ..	89
Mauritius	9	Demerara. Teleg. mat. ..	766
Melbourne	286	Durban	1,745
Naples. Teleg. mat.	100	East London	159
Paris	24	Gibraltar. Teleg. apprts. ..	36
Port Elizabeth	852	Hambro. Teleg. mat.	300
Sevastopol. Teleg. cable ..	1,200	Hong Kong	404
Shanghai	135	Labuan	39
Singapore	44	Launceston	58
Sulina. Electric detonators ..	65	Malta	68
Sydney	796	Melbourne	243
Yokohama	30	Monte Video	21
		Paris	165
		Penang. Teleg. mat.	40
		Port Said	27
		Rio Janeiro	83
		Santos	15
		Shanghai	2,062
		„ Teleg. wire (old) ..	92
		Singapore	337
		St. Petersburg	78
		„ Teleg. wire ..	89
		Stockholm	308
		„ Teleg. wire ..	46
		Sydney	1,092
		Teneriffe	12
		Tientsin	220
		Wellington	221
		Yokohama	68
		„ Elec. wire	333
		„ Elec. cable	133
Total ..	£7,775	Total ..	£11,349

Foreign Goods Transhipped.

Alexandria.	Elec. supplies. Value £106

Anglo-German Competition in Russia.—The British Consul-General at St. Petersburg, in a recent report, shows that Germany is competing with us for the foreign trade of Russia with great success. He thinks the further development of this successful competition can best be met by greater activity on the part of British manufacturers, who should study previous Consular reports from Russia as to the methods to be employed; but he emphasises the importance of adopting the German system of frequently sending competent agents to Russia. The *Times* quotes the report at some length. It also mentions that a report from our Consul at Moscow says that while the machinery for cotton and flax spinning and weaving continues to be procured from England, mill engines are being got in increasing numbers from Switzerland, boilers from Poland, steam pumps and machine tools from America, and electrical machinery from Germany and Switzerland, though 10 years ago most of these went from England. In view of the ever increasing importance of Moscow, which is now the real commercial capital of Russia, he thinks British manufacturers and capitalists should give it more attention than they do at present.

Annual Outing.—The 14th annual outing of the employés of Mr. G. Stegmann took place on Saturday, 26th ult., when a most enjoyable day was spent on the river, starting from Richmond by steam launch. Lunch was served at Chertsey.

Auction Sale.—Messrs. Fuller, Horsey, Sons & Cassell, are instructed to sell by auction, at H.M. Dockyard, Chatham, on September 28th, at 11.30 o'clock, 10 electric light engines and dynamos, electric cable, gear, &c.

Bankruptcy Proceedings.—In *re* the bankruptcy petition of Henry William Thane, electrical and general engineer, 32, The Hill, Northfleet, near Gravesend. The debtor's summary of affairs show gross liabilities at £144 15s. 9d. The assets include £25 worth of stock-in-trade, and a few pounds are set down for machinery, trade fixtures, &c. There are also a few book debts, and a deficiency is shown of £101 7s. 3d. Debtor states that the cause of his failure is insufficient trade to meet expenses. Nearly the whole of the scheduled debts are with trade creditors.

The first meeting of creditors and the public examination in *re* the failure of S. F. Walker, electrical engineer, Cardiff, are to be held on September 11th and October 3rd respectively, at Cardiff.

Liquidations, Dissolutions, &c.—A meeting of the Northern Counties Electric and Motor Company will be held at Town Hall Chambers, Halifax, on October 4th, to hear an account of the winding up from the liquidator, Mr. J. Robinson.

Messrs. A. S. Jones and J. Ritchie (A. Savory Jones & Co., electrical and mechanical engineers, Oriel Road, Bootle) have dissolved partnership. Mr. Jones attends to debts.

Catalogues.—An illustrated list of electrical novelties and appliances comes to hand from the Ohio Electric Works, Cleveland, Ohio, U.S.A.

The General Electric Company sends us an illustrated list of the "Carsak" primary batteries.

From Messrs. Dick, Kerr & Co., we have received an illustrated circular describing the Solenoid blow-out series parallel controllers which are being used on a number of English electric tram lines, including Blackpool and Fleetwood, Dover, Dublin, Hartlepool, Liverpool Overhead and Waterloo and City Railways, and will be largely employed on the Bolton and Liverpool tramway systems.

Messrs. C. A. Vandervell & Co., of Thorpe Works, North Kensington, send us a set of illustrated price sheets of pocket batteries, portable lamps, cycle lamps, accumulator plates and accessories, measuring instruments, small dynamos and motors, &c.

Change of Name.—The name of the House-to-House Electric Light Supply Company has now been changed to the Brompton and Kensington Electricity Supply Company, Limited, and all communications should be addressed in that manner to Richmond Road, Earl's Court, S.W.

"Combricant."—This is the name of a new lubricant being introduced by the Lubricant Company, of Charles Road, Small Heath, Birmingham. We have received a sample tube of "Combricant," which we understand has been extensively tested on a number of public and private electricity plants with satisfactory results.

Commutator Burnisher.—The Edison & Swan Company sends us a list of its patent "Ediswan" commutator burnisher, which provides a simple means for keeping commutators in a perfectly clean condition. The trouble and inconvenience of "turning up" the uneven surface of a commutator frequently prevent this necessary duty being performed by the attendants of the machine, with the well-known deteriorating results to the commutator. This patent burnisher reduces the expenditure of labour required to a minimum, and the machines can always be run with a smooth and even-surfaced commutator, free from sparking and the consequent

increased wear of the brushes. In operation, a strip of emery or polishing cloth, the same width as the burnisher, is cut, and one end inserted under the clip at the front end; it is then turned back under the flexible backing and applied to the commutator. The flexible backing is made in such a manner that it easily adapts itself to the curve of the commutator, but will not fall into depression on the surface. Thus the whole surface is evenly scoured with emery cloth to any degree of roughness required and afterwards polished.

Copper.—The *Financial News* says that movements of copper during August show a reversal of the conditions which obtained during July, a falling-off in the supplies and an increase in consumption resulting in the price of g.m.b.'s and standard copper going up again to £76 15s., at which it stood at the end of June, July having witnessed a decline of 10s. According to Messrs. H. R. Merton & Co.'s statistical circular, the deliveries last month were 18,595 tons, and the supplies 17,965 tons, and the stock now stands at 32,389 tons, a falling off of 630 tons. As compared with July, supplies were 2,377 tons less and deliveries 2,268 tons more.

Correction.—In our last issue we stated that Messrs. Sax, Slatter & Co., Limited, had removed to Basil Street, Sloane Street, S.W., from Foresters' Hall, Clerkenwell. As a matter of fact, the firm in April last, removed *from* Basil Street *to* Foresters' Hall, and the latter is the correct address. We are asked to correct the error as having closed their installation department which was originally carried on at Basil Street, Sloane Street, S.W. Messrs Sax, Slatter & Co., Limited have now ceased to do contracting work, and only carry on their wholesale department at Foresters' Hall, Clerkenwell.

Dynamos and Motors.—Mr. T. Harding Churton, of Leeds, is endeavouring to keep pace with the times by adopting advanced methods of manufacture for dynamos and motors. He is adopting the standardisation method for manufacturing parts, so that they may be in stock whenever required. The necessity for English firms to work on these lines has been many a time shown to be imperative, if they are to hold their own against foreign competition. His list of continuous current dynamo machines and electric motors for electric lighting and transmission work is before us. The con-

tinuous current motors detailed in this list are made to gauge, and they may be fitted with pinions for tooth gearing, or with pulleys for belt driving, or may be made for worm gear to suit requirements. The steel-armoured and enclosed motors, as shown in our illustration, are made with two and four poles, with slotted or plain armatures according to the purpose for which they are intended. They are claimed to be substantially reliably made, and motors of this type running in colliery work have run for six weeks continuously at varying loads. Others have been run for a long time, fluctuating from no load to full load without sparking. Shunt series and compound wound continuous current dynamos for 100, 140, 200, and 500 volts, are shown and briefly explained in the list, and prices are given. Among the installation contracts which have been recently carried out by Mr. Churton are the following:—An installation comprising two gas engines of 30 B.H.P., and two compound wound dynamos, switchboard, wiring, &c., and 58 arc lamps, for the Leeds Corporation. An installation comprising two dynamos, one of capacity for 1,200 lights, and the other for 150 lights, switchboard and wiring, &c, for Messrs. J. Hepworth & Son, Limited, Clothing Factory, Leeds. Electric pumping plant, consisting of 10-H.P. dynamo and motor working at 400 volts, the pump being about a mile distant from the dynamo; switchboard, insulated cables, gearing, &c.; electric lighting installation, 150-light dynamo, &c., for the Newmarket Haigh Moor Colliery Company, Oulton, near Leeds. Installation for lighting surface and pit of the Monk Bretton Colliery, near Barnsley, with about 150 lamps, dynamo, switchboard, &c. The dynamo here has worked day and night without a stop for six weeks together. A second dynamo has been recently supplied as stand-by.

Educational Notices.—The syllabus of lectures in the Engineering Department at the City of London College, Moorfields, under Prof. H. Adams, has been issued; also the complete syllabus of day and evening classes at the College. The new term commences on Monday September 25th.

The new session in Architecture, Building Construction, &c., at King's College, opens in October, and a syllabus of the day and evening classes can be obtained on application.

Explosion.—It is stated that on Monday an explosion, cause not stated, occurred in the electrical department of the Clydebank Shipyard with somewhat serious results.

Explosion at Silvertown.—On Tuesday afternoon an explosion occurred at the India-Rubber Company's Works at Silvertown, in an experimenting laboratory, and, in attempting to extinguish the flames, a man named Wood, aged 20, was severely injured by falling through a skylight. Much damage was done.

Fire.—It is stated by Reuter that on 30th ult., in the evening, a serious fire broke out in some large electrical works at La Chapelle Triage, by which the Chapelle and St. Denis railway stations are supplied. Damage was done to the extent of 1,000,000 fr. No one was injured.

Fire Resistance Materials at the Paris Exhibition.—There will be an important collective exhibit at the forthcoming Paris Exhibition, representing the fire resisting materials, system of construction, and appliances of Great Britain. The arrangement of this collective exhibit (the first of its kind) is in the hands of the British Fire Prevention Committee, to whom the Royal Commission has allotted the necessary space gratuitously, recognising the national importance of the idea, and the disinterestedness of the effort being made by the Committee to show what the country can produce in this direction. Mr. Frederick R. Farrow, F.R.I.B.A., chairman of the commercial section of the Committee has kindly undertaken the direction of this collective exhibit, and it has been decided that all applications from all British and Colonial firms to be represented in this national exhibit, must reach the offices of the Committee by October 7th. The Committee itself will exhibit a model of its testing station, specimens of reports, and the like.

Gas Motor Car.—We illustrate herewith a convenient form of gas motor car patented and manufactured by Mr. W. H. Dunkley, of Birmingham. It is intended for two adults, as a phaeton, or for two children and a governess, or one adult. It is driven by a Dunkley gas motor, which is constructed so as to be capable of taking in gas from any ordinary gas pipe, with a gas bag attached, or to work with gas that is generated and made as required, as the car goes

along. The speed is from two to twenty miles per hour; it is 5 feet long, 4 feet 6 inches high; and 2 feet 8 inches wide, permitting it to go through any ordinary doorway and stand in any ordinary room. It weighs about 4½ cwt., has two brakes, can be stopped instantly, and will turn in the narrowest streets, easily controlled by a youth or governess. Freedom from smell, vibration and noise, is claimed, and it is guaranteed fireproof. It would be interesting to hear how the car generates the gas as it goes along.

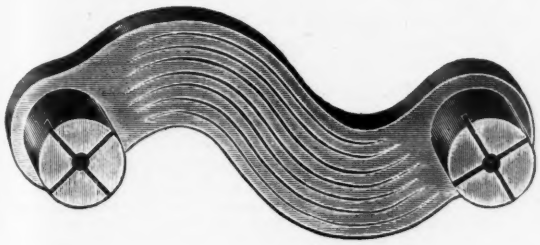
Hopkinson's Valves.—From Messrs. J. Hopkinson and Co., Limited, of Huddersfield, we have received illustrated catalogues describing the special features of their patent valves, including the patent "Ris" valve, patent isolating valves, and blow-off and scum valves. Each of the lists is well arranged and illustrated, and prices are given.

Madras Electric Tramways Company.—Some notes to hand from an Indian newspaper, state that on August 15th a meeting of shareholders in the above company was held to consider the company's position in connection with the threatened bankruptcy proceedings. Mr. Norton, the chairman, explained that the Electric Construction Company, to which the Madras Tramways Company was indebted to the extent of £65,000, had instituted proceedings in London and filed a petition for the liquidation of the Tramway Company. Mr. Norton strongly criticised the gross mismanagement of this magnificent property, for which he held the directors principally responsible, while the shareholders were extremely apathetic and allowed the directors to do practically what they liked. After a lengthy speech it was resolved that a subscription of 4 annas per

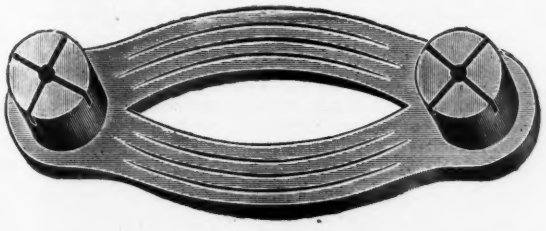
share be levied to meet the legal expenses in London, that the solicitor, Mr. Tasker, should be asked to protect the shareholders' interests in London, that the Committee be authorised to form a company for the purchase of the Madras tramways, and that an issue of 15 lakhs first mortgage debentures on the tramway be made, preference being given to the original shareholders.

New Electrolytic Works.—A Manchester paper says that land has been purchased at Cledford Bridge, Middlewich, by the Parent Electrolytic Company, and a subsidiary company has been formed to manufacture chemicals by a new electrical process.

A New Flexible Rail Bond.—To the various bonds manufactured by Messrs. Felten & Gilleaume, Mulheim-on-Rhine (Germany), and of which large quantities are already in use in the United Kingdom, another new type has been added by them, of which an illustration is given herewith. This new bond has the great advantage over other similar bonds that it is like their ordinary



"Neptune" bond, drop-forged out of one piece of copper, so that there is no weld or joint in them whatever, whereby the highest perfection obtainable is secured. The bond is designed for use in the web of the rail underneath the fishplate, and is fixed in the same method as the "Neptune" bond, viz., by expanding the head of the bond by steel drift pins. In order to provide for the vibrations of



the rails, the body of the bond has been made flexible by means of narrow strips. The sectional area of the body is equal to that of a 6/0 S.W.G. round wire, and the heads are made for ½ inch holes in the rails, although other dimensions can be made to order. Messrs. Felten & Gilleaume's price list for copper bonds is now being revised.

South African Electrical Notes.—The current issue of the *British and South African Export Gazette* contains the following items of electrical interest:—

The electric lighting installation ordered by the Langlaagte Exploration and Building Company, for the Mayfair township, Johannesburg, has been delivered.—The electric lighting and power plant of the Globe and Phœnix Gold Mine includes a 30 kw. generator of the four-pole type.—A 15 h.p. motor is also to be installed at an early date.—A complete electric lighting equipment is under order for the Surprise Gold Mine, Rhodesia.—An additional generator for supplying power to the slimes plant is to be erected at the New Primrose Gold Mine.—Considerable orders for telephone plant and material for the East London (Cape Colony) telephone service are in the hands of makers.—The equipment of the Kimberley electric lighting scheme, the contract for which is being carried out by Messrs. Reunert & Lenz, Johannesburg, includes four dynamos, each of 75 kw., 220 volts, and a capacity of 300 amperes. They are being manufactured by the New York General Electric Company. The cables employed will be from the works of Messrs. Johnson & Phillips, Limited.—A Fowler-Hall alternator of 180 kw. (about 240 h.p.) has been erected at the East London Electric Lighting and Tramway Works, and a second is on order. These are to be used for incandescent street and private lighting. The two tramway and arc lamp machines are also of 240 h.p. each.—An order for two dynamos, each capable of an output of 350 kw. as a continuous load, to cost £3,150, has been placed with the South African General Electric Company (Messrs. G. Findlay & Co.) by the Capetown Town Council. The dynamos, we believe, will be of American pattern.

Traction Equipment Contracts.—The London correspondent of the *Street Railway Journal* recently stated that contracts were ready for giving out for the 15-mile light railway to connect Ramsgate and Margate, in which scheme Mr. Wm. Murphy is the moving spirit. It is further stated that the entire contract for the electric equipment of the Rheims (France) Electric Tramway has been taken by the Paris house of Robert W. Blackwell & Co. The same concern has also received the contract for the additional rolling stock required by the Marseilles electric lines.

Trade Announcements.—We observe that the firm of R. W. Blackwell & Co. has now been registered as a limited company under the title of Robert W. Blackwell & Co., Limited. The registered offices are at 39, Victoria Street, Westminster, London, S.W., and the capital £200,000. This company will take over as a going concern, the business of engineers and contractors heretofore carried on by Messrs. Blackwell at 39, Victoria Street, Westminster, London, S.W.; 133, Bermondsey Street, London, S.E.; 20A, Chapel Street, Liverpool; 50, Boulevard Haussmann, Paris; and 120, Liberty Street, New York. The directors of the new company are Robert Winthrop Blackwell, Philip Dawson, and Benjamin Hunting Howell, managing directors (present partners in the firm of Robert W. Blackwell & Co.), Sir Charles E. Howard Vincent, and Francis Henry Barker.

The registered offices of La Capital Tramways Company, Limited, La Capital (Extensions) Tramways Company, Limited, and La Capital Traction and Electric Company, Buenos Ayres, Limited, have been removed to 19, Finsbury Circus, E.C.

Messrs. Wm. Whitehouse & Co., fittings manufacturers, of Birmingham, have appointed Mr. H. Adlam to represent them in London. The showroom will be at 59, Holborn Viaduct as heretofore.

Western Union Telegraphic Code and International Cable Directory.—In the High Court of Justice on Wednesday last week, Mr. Joseph moved before Mr. Justice Cozens-Hardy, sitting as vacation judge, to expunge an entry in the minute book of the International Cable Company, of New York, as registered proprietors of the copyright of the Western Union Telegraphic Code, and that the company should be condemned in costs. Counsel asked that the case might stand over for a week. The Mercantile Publishing Company were the registered proprietors of a code called the "Broomhall's Comprehensive Cypher Code," which was registered in 1895, and was assigned to the Mercantile Publishing Syndicate in January, 1896. In August, 1898, the International Directory Company, of 30, Broadway, New York, U.S.A., were registered as the proprietors of the code, and an action was brought against them in July last with the result that an injunction was granted restraining the publication or importation of this code; he suggested that the matter should stand over. Mr. Bucknill consented. His Lordship ordered that the matter stand over until the second motion day in the next sittings.

ELECTRIC LIGHTING NOTES.

Aberdeen.—Several Scotch papers record an enormous increase in the business of the electricity supply works at Aberdeen, by saying that the increase in current supplied during the past seven months was "75,527 *volts*" more than for the corresponding period last year. The total revenue for current supplied during the past year has been £4,804, a decrease of over £900 compared with the preceding year. The expenditure was £2,081, against £2,596 for 1897-98.

Beverley.—The town clerk is to continue his inquiries *re* electric lighting in other towns, and report to the next Council meeting.

Cardiff.—On a wet day last week there was a leakage of current from the mains in St. Mary Street. Several passers by are reported to have received shocks. The first to notice the occurrence was a little dog, who went up to an iron pillar in the usual way.

Carlisle.—The General Purposes Committee have had before them the tenders for the plant required for electric light extensions, and have appointed a sub-committee to confer with Prof. Kennedy *re* same.

Cheltenham.—A special Council meeting is to be held to resolve to apply for a provisional order for the extension of the electric light area at Charlton Kings, Leckhampton, Bishop's Cleeve, and other adjacent villages. A Local Government Board inquiry is to be held *re* the proposed loan of £16,600 for electric lighting.

Dolgelly.—A member of the District Council is calling attention to the desirability of having the town lighted by electricity.

Edinburgh.—A steam pipe at the Dewar Place electricity works burst on Tuesday last week. No one was injured.

Germany.—A company is in course of formation in Chemnitz to establish a large central power station to supply energy to an electric tramway between that town and Burgstadt, and for lighting purposes to a number of small towns in the district.

Glasgow.—The Watching and Lighting Committee last week considered the minutes of the sub-committee on electric lighting of streets, from which it appeared that it had been remitted to the inspector of lighting and the electrical engineer to report how to modify the cost of electric lighting. Mr. Chamen, the electrical engineer, had reported that he did not think any increase in the distance between the lamps could be safely recommended. The average distance apart, as proposed by the inspector of lighting, is 50 yards, and that is the practice usually adopted in all other important cities. For outlying districts it might be possible to increase the distance to 60, or even 70 yards; but if arc lamps were spaced thus far apart, the space between them would appear to the eye far darker than it really was. The electrical engineer also pointed out that in Princes Street, Edinburgh, the lamps are only an average distance of 45 yards apart, and are about half as powerful again as those in Glasgow. The conclusion he came to, therefore, was that he could not take the responsibility of advising that the arrangement and number of lamps be in any way reduced; and he further pointed out that the price of £14 per annum per lamp for lamps lighted the

whole night through was the lowest in the kingdom, with the exception, perhaps, of Edinburgh, where, however, the price of £14 per lamp per annum is an all round price for lamps lighted—some all night, and some half the night. On the other hand, the capital cost and maintenance of the arc lamp pillars, lamps, and all accessories, is borne by the Electricity Department. The inspector of lighting, in his report, detailed the routes to be dealt with. The sub-committee recommended that the streets described in the report be lighted by electricity. The Watching and Lighting Committee approved the minutes.

Consumers have been circularised by the Electricity Department *re* systems of charging for current, and asking under which system they prefer to be assessed, viz:—

1. On the Maximum Demand System.—For any quantity of current taken up to, but not exceeding the maximum demand for 365 hours in the 12 months, from June 1st, 1899 (being an average of one hour per day), 6d. per Board of Trade unit; all current consumed over the above-stated quantity 1½d. per Board of Trade unit. With the alternative of paying on—

2. The Fixed Charged System.—A fixed charge of 4s. per annum for each 8 c.p. (32-watt) lamp, or its equivalent, fixed in consumer's premises (or £6 5s. per kw.), this charge being spread uniformly over the 12 months from June 1st, 1899, and an additional charge for all current used as recorded on the meter of 1½d. per Board of Trade unit.

Consumers who take a supply of current for the equivalent of five hours or more per day for 365 days per annum, to be charged throughout at the rate of 1½d. per unit.

It is expected that the scheme for electrically lighting the Glasgow Harbour will be completed next month. Most of the small cranes in the Prince's and Kingston Docks will be worked by electric power.

Grays.—Mr. Preece has advised the District Council that there will be no difficulty in supplying Little Thurrock with electric light if that district obtains an order. The Council is making inquiries.

Halifax.—Tenders for masonry, joiners', plumbers', and other work in connection with the extension of the electricity works have been accepted.

Heckmondwike.—The Council has considered plans and estimates, prepared by Mr. Hawtayne, for electricity works, and the Electric Lighting Committee's recommendation to apply for a £14,000 loan to carry out the scheme, has been adopted.

Hereford.—The laying of electric light cables is nearly finished. It is thought that the works may be ready for opening at the end of October.

Hertford.—The *London Gazette* contains the usual formal notice of the intention of the Council to transfer its provisional order to the North Metropolitan Electrical Power Distribution Company, Limited.

Islington.—The Vestry is now commencing supply of current in various thoroughfares in Highbury Park at 200 volts.

Lambeth.—Work is progressing at a rapid rate at the electricity works with a view to being ready for the coming winter.

Leeds.—Since the electric lighting works of the Yorkshire House-to-House Electricity Company were taken over by the Leeds Corporation, towards the end of last year, the plant has been gradually extended to meet the growing demands. The Lighting Committee is not only adding to the machinery at present in use at the works in Whitehall Road, but is also taking steps to have extensions of a more comprehensive character carried out. Four new Lancashire boilers are nearly ready for use—these being of the type previously used. The management are also putting in, as an experiment, a boiler of the Babcock & Wilcox water-tube type. A 1,000-H.P. combined dynamo and engine is also being ordered, and two others of the same size are being constructed, one of which is to be at work before the winter. These are improvements that are to be carried out on the existing premises. With the demolition of the Britannia Mills, which has just begun during the last day or two, says the *Yorkshire Daily Post*, the Corporation will have at their disposal a valuable area for extension purposes. The Britannia Mills, which adjoin the present works and have a long frontage to Whitehall Road, cover an area of an acre and a half, or half an acre more than that on which the electric works now stand, and the space will be used to better advantage, inasmuch as the engines being of greater capacity than those on the other side, space will be economised. The cost of the old mills was included in the £217,000 purchase money that the Corporation paid to the Yorkshire House-to-House Company. For the erection of the new building and for its equipment, it is proposed to raise £150,000, and application for permission to borrow the money has been made. The engineer of the works (Mr. H. Dickinson) is just returning from the United States, where he has been making inquiries as to the different systems of generation and distribution of electric light, and Messrs. Hopkinson and Talbot are also to report as to the best plan to be followed in future work. The number of lights now connected with the mains is fully 50 per cent. more than it was at the same time last year. It should be added that the mains in the Hunslet district are just completed, and intending consumers in that part of the city may have their supply almost at once.

Liverpool.—The Electric Power and Lighting Committee recommended the Council at their meeting on Wednesday to accept a tender for the erection of an electric power station in Lister Drive for a sum of £49,783, and tender for the supply of three engines at a cost of £6,939 each, and three at £1,377 each, for the Lister Drive and Cobb's Quarry electric stations.

Llandilo.—The ratepayers are asking the Urban Council to take a house-to-house canvass *re* the electric lighting question.

An expert who recently gave an opinion *re* a scheme, calculated that the total cost of a 220-volt continuous current service would be about £2,900. Another £200 will have to be spent upon a provisional order. £500 may be saved if the Board of Trade will sanction the use of overhead mains. Within a couple of years 2,000 lamps will probably be used, giving an approximate revenue of £1,000 a year. The ratepayers' meeting sanctioned the Council to proceed with a complete system.

Norton.—The Council has informed Messrs. O'Gorman and Ocsens-Hardy that it will be glad to consider any particulars they may be able to submit *re* electric light proposals for Norton.

Paisley.—The electricity works are all but completed. The total capacity of the plant is 18,000 8-c.p. lamps. Current was to be switched on on 5th inst. by the chairman of the Electric Lighting Committee.

Penarth.—It is stated that the Electrical Power Distribution Company will start immediately to construct electricity works near Lower Penarth.

Peterborough.—A request from a local company to be allowed to run an overhead wire from one depôt to another a short distance away for electric lighting has been refused by the Council.

Shoreditch.—The Lighting Committee, at a meeting of the Vestry on Tuesday, recommended the authority to purchase from Messrs. Lines for £14,500, the freehold of the wharf property facing Bath Place and Whiston Street for the purpose of a new generating station. Mr. H E. Kershaw, in the absence of the chairman of the committee, moved the adoption of the recommendation. He stated that within 12 months the whole of the present plant and the new engines would be fully loaded, and that the Vestry would then be called upon to provide more light. The profit on the electric light undertaking during the past year exceeded that of the previous 12 months, and the authority would meet the reward of its municipal enterprise by undertaking the new scheme. There had been, the speaker said, a magnificent profit during the past year of between £3,000 and £4,000. Mr. Hall having seconded the motion, Major Wenborn proceeded to condemn the price proposed to be paid for the site as being excessive. Mr. Winkler said they were told years ago that the heat from the refuse would provide all the light required. Looking at the question now there was a great difference. There were five boilers in position, and the new scheme would involve a further expenditure of, perhaps, £30,000. He contended that the Vestry had been deceived in the matter; the destructor did not pay, and the speaker had always pointed out that it would not yield a profit. Other members having spoken, Mr. Kershaw, in reply to the discussion, said that he agreed that the price to be paid was high. *He would take that opportunity of withdrawing the statement which he made at the opening of the station—that the destructor would generate all the steam required;* but it was not possible at that time to foresee that the undertaking would grow to such a large extent. It was not true that the Vestry had been deceived as was suggested. If the destructor was allowed a fair value for the steam supplied and for the destruction of the refuse, a profit was shown on that department. On being put, the recommendation of the committee was adopted without any dissentient. It was decided to enter into a revised contract with the Brockie-Pell Arc Lamp Company, owing to the discontinuance of incandescent lamps on the street arc lamp standards, and by means of which a saving of £3 11s. per standard will be effected.

The Vestry on Tuesday approved regulations for the supply of electric current to tenements on the Moira Place and Plumber's Place areas, where workmen's dwellings have been erected by the Vestry under the Housing of the Working Classes Act. Among the regulations are the following:—

The main switches for regulating the supply will be under the control of the superintendent. The current to the rooms will be turned on each day at dusk and turned off at midnight. From October 1st to March 31st, the current will also be turned on at 5 a.m., and turned off at daylight. Tenants will be charged for the supply of electricity by an increase of the rent to the extent of 8d. per week for a two-room set, and 10d. per week for a three-room set, and such increased rent with any sums due for breakages, damages, or the like under these regulations will be recoverable as, and form part of the rent as and when the same becomes payable. One 16-c.p. lamp will be fitted in the living room, and one 8-c.p. lamp in each of the bedrooms. The Vestry will pay the cost of supplying and fixing wires and lamps and of renewing such lamps and wires except when broken or damaged by the tenant.

The Scottish Borders.—The Lighting Committee of St. Boswells have instructed Mr. Purves, Edinburgh, to make application this autumn for a provisional order for electric lighting. Mr. Purves has also suggested a scheme for Kelso, which he states to be admirably situated for the purpose, and the scheme includes the running of an electric tram from the town to the station. Hawick and Galasbiels have also schemes under consideration.

Simla.—The electric lighting of Viceregal Lodge, Simla, will be thoroughly renovated next season at a cost of about 96,000 Rs. The present installation, which is 13 years old, is, according to a Delhi paper, obsolete and the plant now worn out.

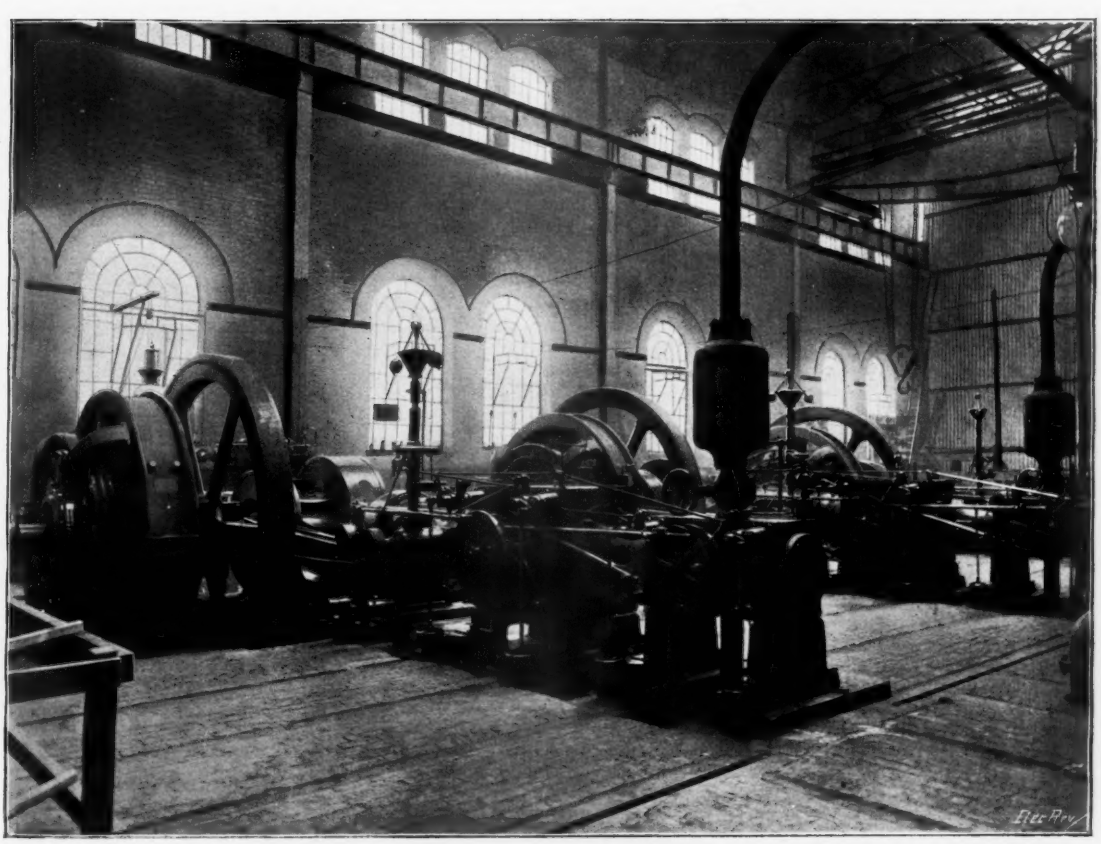
Stoke-on-Trent.—The Board of Guardians has appointed Mr. G. R. Peers, of Manchester, to make an examination of the workhouse, and report to the Board upon the advisability and cost of installing electric light.

(*Continued on page* 404.)

SHEFFIELD CORPORATION TRAMWAYS.

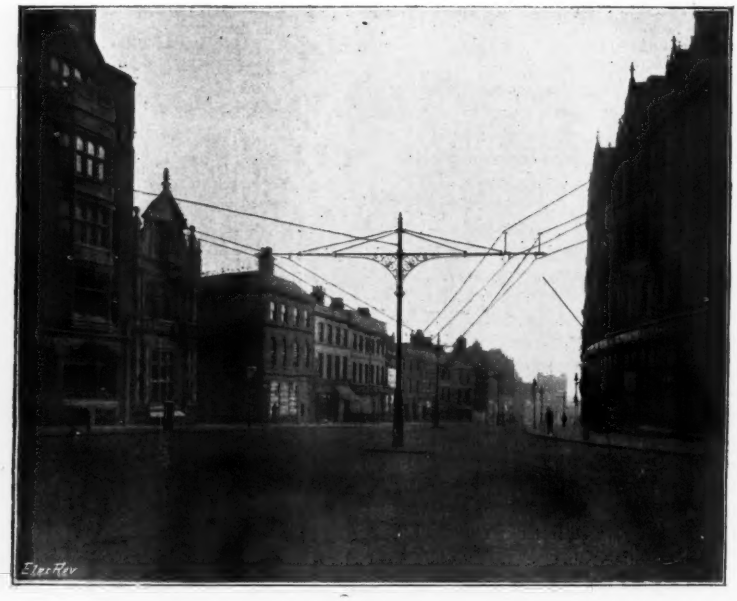
The city of Sheffield has a population of over one-third of a million, and covers an immense area, the outside measurements of the boundary being 4 miles by 12 miles; it is also very irregular, some parts of the city being a quarter of a mile higher above sea level than others. It would seem that here is a splendid field for mechanical traction, the gradients being too severe for animal haulage, except on certain routes. The old horse tramways first laid by the Corporation in 1872, and leased to a company, consisted of about 9¼ miles of double line; they remained at that figure for 24 years, when the lease expired. The Corporation then took over the working of the lines, and set to work with energy to popularise and improve the system. A deputation visited a number of British and Continental cities in September, 1896, to study the methods adopted there, with the inevitable result that electric traction on the overhead system was adopted, as being most suitable for the conditions prevailing at Sheffield. In 1897 powers were obtained for the construction of about 27 miles of double track, in addition to the 9 miles already existing, at an estimated cost of over £600,000, including electrical equipment. The work has been carried on rapidly, and the first 5 miles to be electrically equipped was inspected, on behalf of the Board of Trade, by Col. Marindin on August 25th for the Railway Department, and Mr. Trotter on August 29th for the Electrical Department. The first section of the lines, from Tinsley to Nether Edge, commenced regular running on Monday last; the Walkley section is also complete, but as

Street View.



Interior of Power House.

this abounds in excessively steep gradients, including some of 1 in 10, the drivers are to have a longer period of probation and training.



Street View.

The whole of the line work on the Nether Edge and Tinsley sections was done by the British Thomson-Houston Company. The equipment, including the generating plant, &c., was contracted for by the British Thomson-Houston Company, Limited. The extensions are being carried out by the Corporation staff.

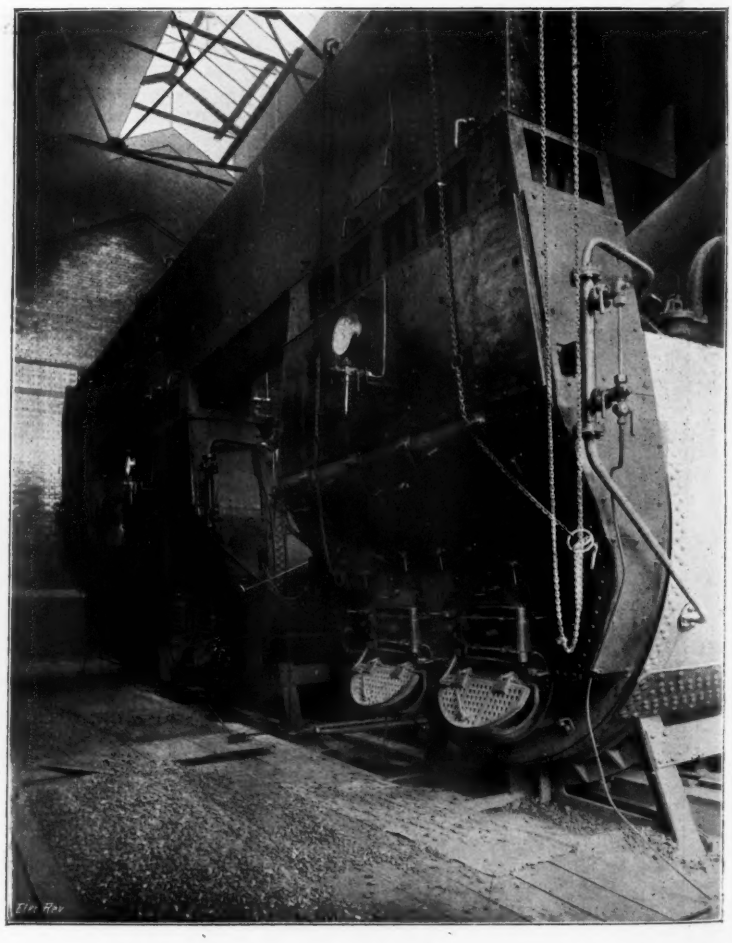
The power station consists at present of a building 110 feet wide, 90 feet long; the work of doubling the length is already in progress, and part of the additional machinery is almost ready for erection. The boiler house adjoins the engine room, and as will be seen from our illustrations, is very different from what we are accustomed to find in electricity works.

The boilers are of the marine "wet-back" multitubular type, and stand upon cast-iron chairs, without brick setting. They were built by Messrs. Vickers, Sons & Maxim at Barrow, and fitted with "Serve" tubes, "Ellis & Eaves" induced draught system and air heaters, by Messrs. John Brown & Co., Limited, Sheffield. Each boiler has two furnace tubes of the "Purves" ribbed type, somewhat resembling the Fox corrugated flues, but with ribs at intervals only; the combustion chamber, as the name "wet-back" implies, is entirely within the boiler, and the gases are returned to the fore end by "Serve" tubes of welded steel, which provide a large heating surface by means of inwardly projecting longitudinal ribs. The waste gases pass into a smoke box over the furnace doors, then through a large number of vertical tubes into the common flue above the boilers; from this they are drawn through trunks by fans and driven up the short steel chimney shaft, or at slack times they escape by natural draught. The air supply to the furnaces is admitted through traps seen in the front view of the flue, round the up-cast tubes from the smoke box; it then flows round the sides of the latter into the furnaces. The fans are two in number, direct driven by enclosed engines, which as well as the fans were made by Messrs. Thwaites Bros., Limited, Bradford.

The boilers work at a pressure of 160 lbs. per square inch, and are provided with thermometers and water gauges to show the state of the draught; they are fired by hand with small coal, and are each capable of evaporating 8,000 lbs. of water per hour. Four more boilers are on order, similar to those at present installed; they will be placed closer together —13 feet centres, instead of 17 feet 6 inches—and there will be one fan to three boilers, instead of 1 to 2, as at present. Mr. Fell also intends to instal conveyors, with automatic weighing machines, which will record the weight of coal received and the amount delivered to each stoker. A wide trench is provided under the ashpit doors, to accommodate an ash conveyor; the ashes will be dropped direct into the conveyor, and carried into a receptacle from which they can be removed at convenience.

Behind the boiler house there are coal stores, and a large tank, from which the circulation water is drawn. Water is admitted to the tank by means of a pipe from an adjoining "goit," or cut from the River Don, which flows past the site of the works, practically making it an island; the water is returned direct into the goit. The engineer's office is to be situated behind the boiler house, and over the former is a feed-water tank holding 11,000 gallons.

The steam pipes are of lap-welded steel with screwed

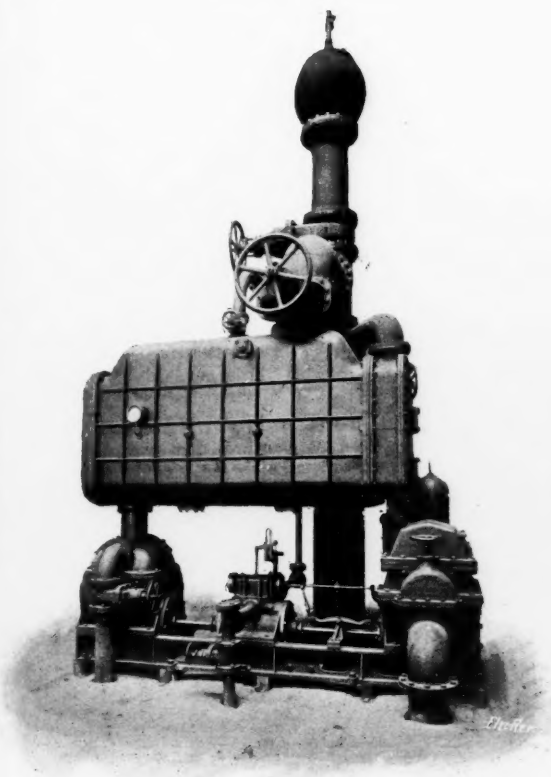


Marine Boilers.

flanges; no ring main is used, the boilers being connected to a single large header running along the boiler house wall; from the header a pipe is led to each engine, passing through a separator immediately above the high pressure cylinder. The steam junction valves in the boiler house, and the feed check-valves are of Hopkinson's make; all the piping was supplied by the Best Fox Manufacturing Company, of Philadelphia.

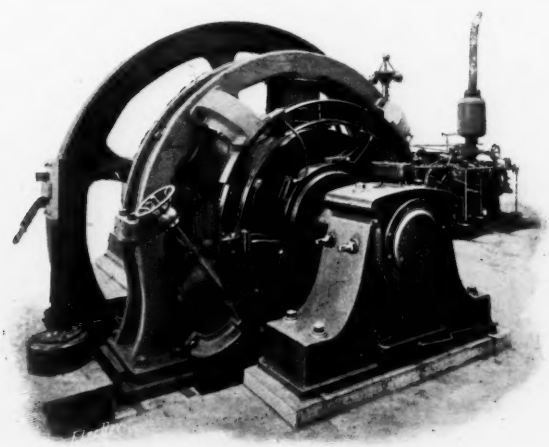
The condensing plant consists of a Wheeler "Admiralty" surface condenser having a tube surface of 1,900 square feet. The condenser is mounted directly upon Wheeler combined air and circulating pumps, as shown in our photograph, in which also the relief valve to atmosphere is seen above the condenser; the steam cylinder is 14 inches diameter, the air and water cylinders 16 inches diameter, and the stroke is 16 inches. The outfit is capable of caring for 19,000 lbs. of steam; it is fitted with Wheeler patent tubes, made of solid drawn brass, well tinned inside and outside, one end of the tube being drawn thick and having a thread chased on same, and screwed directly into the tube plate, thus making a mechanical and permanent joint, which will always be tight. The other end of the tube is secured by means of ferrule and corset lace packing which allows for the full expansion and contraction of the tubes.

Street View.



Condensing Plant.

Both the air and circulating pumps are operated by one steam cylinder. This steam cylinder is fitted with the maker's improved valve motion, which can be adjusted to run a full length of stroke under all conditions of speed, and there is no loss of motion, so that the economy in running this set is claimed to be very low. In the heater the same type of tube is used as in the condenser. The tubes are made of a large size, so that there is ample waterway and no choking of the feed-water on its way to the boiler. The area of the tubes through which the water passes is from five to six times the area of the feed pipe. Two more condensing sets similar to this are about to be erected. There is a horizontal Wheeler feed-water heater placed between the feed pumps and the boilers for utilising the heat of the exhaust steam from the auxiliary plant; the feed-water passes through tubes, the steam being outside. A pair of Edmiston feed-water filters are also provided, and are arranged so that the feed can be sent through either or both filters, or through a by-pass as desired. There are two "Manchester" vertical duplex pumps, made by Messrs. Pearn & Co., Limited, with cylinders 5½ inches diameter, rams 3½ inches, and stroke 5 inches. These, with the feed-heater and filters, are placed beneath the floor of the engine room.

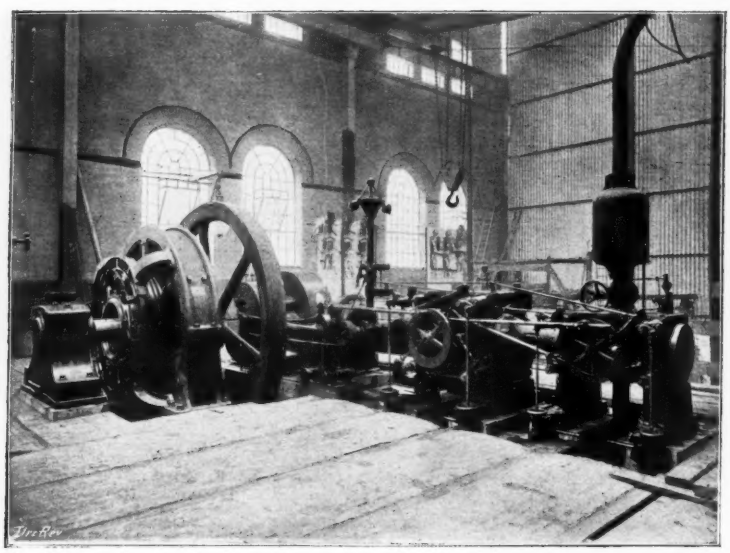


B.T.H. Railway Generator.

The engines are of the "Allis" horizontal tandem compound condensing type, three in number, with cylinders 12 and 22 inches × 30 inches stroke; their normal speed is 135 revolutions per minute, with a steam pressure of 150 lbs. per square inch. Reynolds-Corliss valve gear is used, with trip admission valves, and a gravity governor resembling the familiar Porter pattern. A jockey pulley running on the governor belt is connected by a loose link with the gear, so

that if the belt breaks the engine is stopped at once. The fly-wheel is 12 feet in diameter and weighs 6 tons.

The dynamos are standard B.T.H. six-pole railway generators, with drum armatures about 4 feet 6 inches in diameter, 1 foot 6 inches core width, and weighing 7 tons each.



Allis Engine and B.T.H. Generator.

The normal maximum output is 225 KW. at 500 volts. The field magnets are compound wound for constant pressure (within 2 per cent.) at all loads, with constant speed and fixed position of the brushes. The dynamo is coupled direct to the engine, with the fly-wheel between, and two bearings only are used. The brasses are supported in the middle, so as to be capable of a certain amount of self-adjustment, and the journals are oiled with drip lubricators.

The normal rated output of the engines is 350 I.H.P., but they are able to drive the dynamos at 25 per cent. overload, and the latter are designed to allow of this. An equalising switch is mounted on a pillar close to each generator, for parallel running.

An overhead travelling crane, to lift 20 tons, and made by Messrs. Booth & Bros., Limited, of Rodley, traverses the engine room. The latter is 100 feet long, 50 feet wide, and 40 feet high to the spring of the roof, while an extension 84 feet in length is already partly built. When completed, the room will be a very fine structure. Foundations are being laid for four additional generating sets, two of which are nearly ready for delivery. These will consist of B.T.H. dynamos of 500-KW. output coupled to vertical engines, cross compound, with Corliss valve gear, made by Messrs. Cole, Marchant and Morley, of Bradford. The armature and fly-wheel will be placed between the high and low pressure engines, and the whole will be mounted on a single compound cast-iron bed. The engines are designed for 800 I.H.P. at 90 revolutions per minute, and we are able to take 25 per cent. continuous overload in addition, if required; the fly-wheels, 18 feet in diameter, will weigh 23 tons each. A small 25-KW. coupled set, supplied by Messrs. T. Scott Anderson & Co., Sheffield, and consisting of a Silvertown dynamo and a Clench engine with fly-wheel governor, is used to run the glow lamps in the works.

The switchboard consists of three dynamo panels, two feeder panels, and two Board of Trade panels. The instruments, with the exception of Messrs. Elliott's recording ammeters and voltmeters, are all of the Weston illuminated dial type, and the switch-gear is of the usual B.T.H. type. Two of the Weston voltmeters are mounted on a swing bracket at one end of the board, so as to be visible to the attendant from any part of the switchboard. As may be seen in our general view, a large space has been left between the generator panels and the rest of the board, to provide for four generator panels for the extensions which are in progress.

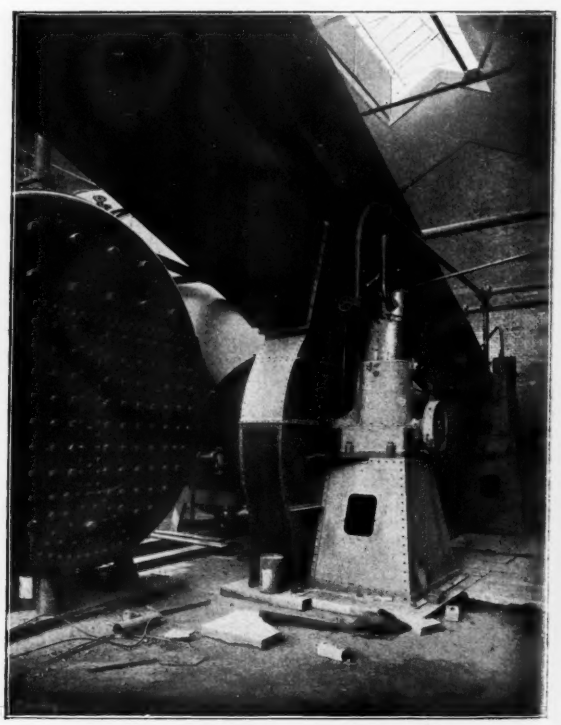
The board itself consists of white marble panels, supported in a cast-iron frame, and was supplied by the B.T.H. Company. The arc lamps in the works are run off the traction bus bars.

There are four feeders—two to Walkley, one to Nether Edge, and one to Tinsley—each to carry 300 amperes. The feeders are joined in pairs, and pass through two K type circuit breakers.

The cables are of the Callender type, insulated with jute saturated with fine bitumen, lead covered, taped and braided, with a specified insulation resistance of not less than 700 megohms per mile after 24 hours' immersion at 60° F. After laying and jointing, the cable must withstand a pressure of 1,000 volts for one hour. Messrs. Callender also supplied the cables connecting the trolley wire with the various feeder pillars, the return feeder cable, and the three-core test cable, the total length being over 13 miles.

The trolley wire feeders are 0·3 square inch in cross section; the return feeders from Tinsley and Nether Edge 0·6 square inch.

The overhead construction consists chiefly of bracket suspension, with centre and side poles; a good example of the former is seen in our photograph of South Street. There is a small amount of span wire work, which we show in a view of Fitzalan Square, as well as an interesting junction in the same neighbourhood. The line material is all of the B.T.H. standard type; the poles and brackets were made by Messrs. J. Spencer, of Wednesbury, and these, we think, show a distinct improvement in appearance over the ordinary designs.



Fans.

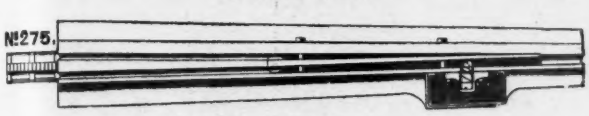
Some few of the poles were supplied by Messrs. MacFarlane, of Glasgow, direct to the Corporation.

The feeder pillars are of the B.T.H. type, and divide the trolley line into sections of a quarter of a mile each.

The track is laid on a 6-inch concrete foundation with rails weighing 108 lbs. per yard, made by Barrow Haematite Steel Company, Barrow-in-Furness, and bonded with Chicago

bonds. The special work at points and crossings was made in crucible cast-steel by Messrs. Askham Bros. & Wilson, Limited, of Sheffield. We show in one of our illustrations a view of an important junction, known as the Ecclesall Road junction. This was laid in about a fortnight, and leads to three important districts, Heeley, Nether Edge, and Ecclesall. All the points and crossings (36) were made in crucible cast-steel, to special angles required, by Messrs. Askham. In addition they have also supplied the drain rails, of which there are some hundreds, used upon the Sheffield tramways, also patent sole plates for junctions. The patent point and the drain

Movable Point.

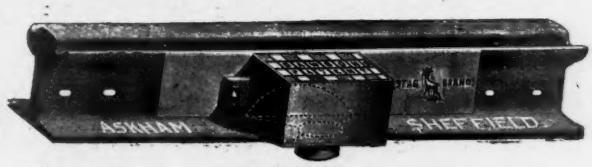


Fixed Points.

rail are shown in the small cuts. We understand that the patent points, of which some thousands have been made, have never yet failed. The loose part, or tongue, being made of forged steel, is not liable to break, and can be easily renewed. The drain rails are cast in crucible steel, and take the place of the ordinary rails for their length, about 5 feet. When connected with the sewers, the roads are drained by means of the slot cast in the groove of the rail, which allows the water to flow freely through. This arrangement is said to save their cost in six months by reduced repairs.

The total length of line equipped by the B.T.H. Company is 5¼ miles (double track). The rails were laid by Corporation workmen, and the overhead construction on the Walkley route was carried out in the same way. The fittings were supplied by the Electric Tramway Equipment Company, of Birmingham, and the trolley wire by Messrs. F. Smith & Co., of Halifax and Manchester. The amount of double track laid at present is about 12½ miles, most of which is ready for electrical working.

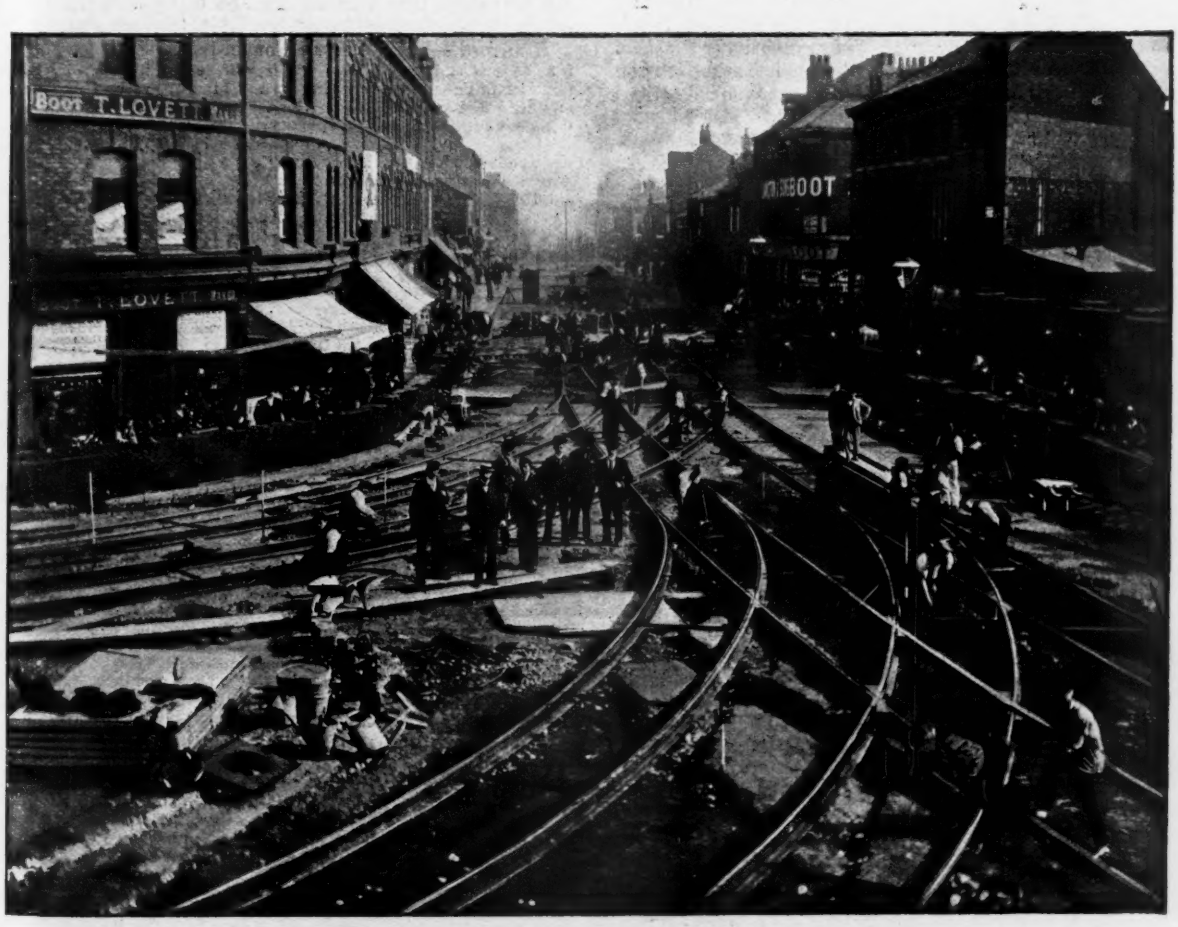
There are 52 electric cars already, and the number is to be increased to 80. Double-deck cars are employed on the Tinsley-Nether Edge route, weighing 8 tons each when empty; but the gradients on the Walkley station are so severe (some 1 in 10), that single-deck cars alone will run on that route, weighing 7 tons each, empty. Each car, in addition to the



Drain Rail.

usual hand brake, has an electric brake, a slipper brake, and trailing Spencer's wedges or scotches. The electric brake consists of two discs, one keyed to the shaft with a feather, the other fixed to the frame of the truck, and fitted with a coil energised by the motors acting as generators. Hard steel wearing blocks are embedded in the discs, and show a marked improvement in the wear and in the smoothness of action of the brake.

The slipper brakes are to be used in descending steep hills, to get the car under control, while the magnetic and other brakes are used for regulating the speed. The slipper is



Special Work at Ecclesall Road Junction.

worked by a large hand wheel outside the ordinary brake handle. The object of the trailing wedge or scotch is to hold the car fast when it is stopped while going up an ascent; the wedge blocks or scotches are dropped behind the wheels by a special handle attached to the dash on the left-hand side of the platform. The handle operates the wedge blocks behind the leading wheels. The Mossberg and the Roller Bearings Companies' bearings have been supplied to some of the cars as an experiment. The trucks are of the Peckham extra long cantilever extension type, and were supplied to the B.T.H. Company by Messrs. R. W. Blackwell & Co. The car bodies are mostly of the top-seat type, built by Messrs. Milnes & Co., Birkenhead, and are capable of seating 22 passengers inside and 29 out. The length over all is 27 feet 6 inches, width over all 7 feet. The approximate weight of the bodies is 65 cwt. each (without trucks or passengers). The single-deckers carry 28 passengers each. All the cars are fitted with G.E.-52 traction motors, of which we gave an illustration last week; the controllers are of the B.T.H. manufacture, type B 13, and there is a magnetic circuit-breaker on each car. The side trolley post is just the same as at Bristol, and is very neat. Each car carries 12 lamps, of which 10 only are alight at one time; these give an excellent illumination, amply sufficient for reading.

Two sample smoking cars are on order, upon which Mr. Fell has spent a considerable amount of time and skill. Each has a small body in the middle, seating 16 persons, and a vestibule at each end seating six persons; but in one case the vestibule is provided with open lattice sides, in the other it is fitted with sliding windows. The driver's platform is completely shut off from the vestibule by a glazed partition.

Thirty cars and trucks have recently been ordered from the Preston Railway and Tramway Carriage Works, Limited, 15 of which will have Brill trucks, and the remainder Peckham trucks. These will be fitted by the British Thomson-Houston Company, Limited, with equipments similar to those described above. The latter company has also on order 25 other equipments, 13 double-deck cars and trucks, two eight-pole 500-KW. generators, two generator panels, and one feeder panel, in addition to the original contract.

We have to acknowledge our indebtedness to Mr. Fell, the city tramways electrical engineer; to Mr. Moller, the resident engineer of the B.T.H. Company, and to other engineers engaged upon the work, for their assistance in drawing up this description and for their courtesy to our representatives on the occasion of their visit; also to the British Thomson-Houston Company, Limited, which has furnished us with numerous details of the plant.

ELECTRIC LIGHTING NOTES.

(*Continued from page* 398.)

Stowmarket.—The Council will not allow the Suffolk Electricity Company to lay wires under a certain roadway for the purpose of supplying electricity to the East Stow Rural District Council.

Todmorden.—The Council has decided to call in an expert to report on the question of erecting works for the generation of electricity for the purposes of lighting, electric traction, motive power, and as to suitable area and the relative advantages of steam and water power.

Turkey.—We read that Sir E. Ashmead-Bartlett, M.P., gave a grand banquet at Constantinople last Saturday, to celebrate the granting of the first electrical concessions ever obtained in Turkey.

Valparaiso.—The *Review of the River Plate* says that a syndicate, called the Electrical Corporation, Limited, has been formed for the purpose of acquiring the concessions granted by the Municipality of Valparaiso to Mr. Josiah Harding, M.I.C.E. The syndicate is backed by some of the most powerful capitalists in London, who are prepared to provide the whole of the capital required for the construction. Mr. Harding recently returned to Valparaiso from Liverpool, accompanied by Mr. Maclaren, the engineer to the corporation, who will come back to England after the above-named preliminaries are arranged, and Mr. Harding will then remain as the representative of the company. Although steam will at first be used for generating the electricity, it is expected that water-power from the River Aconcagua will ultimately be transmitted electrically for the purpose of supplying the necessary current, not only for the tramways, but also for lighting and power throughout the city. The capital for purchasing and transforming the existing horse tramways will be also ready, so that a complete system may be installed as soon as possible.

Wakefield.—Messrs. Laing, Wharton & Down are pushing on with the electric lighting, heating, and power installation at the Wakefield Asylum. The engine house contains four sets of steam dynamos, two driven by 100 H.P., and two by 120 H.P. Willans engines. Electric radiators are provided. The number of lamps is 2,800, of which about 56 are arcs. The work has been in hand for about nine months, and is now completed. Mr. H. Key has supervised the carrying out of the work.

Walker.—A deputation from the Council has visited Oldham and Rochdale for inspecting the electricity works. Negotiations has been opened with the Newcastle Corporation for the purchase of a site for electric works.

Winchcombe.—The Rural District Council has granted formal assent to the Corporation of Cheltenham to establish certain electric works in the parishes of Bishop's Cleeve, Southam, and Woodmancote.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—The laying of rails and preparation of track for the electric tramways is proceeding with great expedition in the hands of Messrs. Macartney & M'Elroy, of London and New York.

Bedford.—The Electric Light Committee recommends the laying of a light railway between Bedford and Kempston.

Blackpool.—Several drivers of cars on the Blackpool and Fleetwood Electric Tramway have been fined sums varying from 10s. to 20s. for furious driving.

Bradford.—The Tramways Committee has let the contract for the rails and granite setts which will be required in the construction of three new electric lines: the White Abbey, the Thornbury and Stanningley, and the Lister Hills. The contract of the Demerbe Company for the whole of the rails was accepted, and the order for the setts was divided among several firms. Five or six years ago, as an experiment for the benefit of the Corporation, the Demerbe Company laid a short length of their rails on the Leeds road section of the Bradford tramways from Chapel Street to Harris Street, a portion of the line upon which the traffic is particularly heavy. The result has been highly satisfactory, and when the Bolton road electric tramway was constructed the rails were used for a length of 1,000 yards, from Bolton Church to the city boundary. They were also used by the Eccleshill District Council for another length of 1,000 yards in their district. That they have answered the purpose is shown by the committee's decision to use them solely in the construction of the three new lines. It is stated that the cost of the construction with the Demerbe rail is about £320 per mile less than with the old girder rail.

Darlington.—At Monday's meeting of the District Council a communication from the Light Railway Commissioners was read, stating that the Commissioners had decided to submit to the Board of Trade an order authorising the Darlington light railways. They recommend that the electric energy should be supplied by the Corporation of Darlington, and it was hoped that the promoters, before the scheme was finally sanctioned by the Board of Trade, would have made this arrangement.

Darwen.—At the last meeting of the Town Council, a statement was made upon the agreement which it was proposed to enter into with the Blackburn Corporation for working the recently acquired tramway between the two towns. It was proposed that instead of Blackburn paying a definite sum to Darwen and taking the whole of the receipts, the two Corporations should take the receipts in their own districts. The cost would be divided according to mileage. It was expected that the work of converting the tramways to the electric traction system would take about 12 months.

Eccles.—The Corporation General Purposes Committee has considered the report of the town clerk as to the proposed construction of electrical tramways from Salford to Whitefield. Six out of the nine districts represented at the joint conference, voted for a syndicate carrying out the whole of the scheme and three against. The borough surveyor, Mr. A. C. Turley, has prepared a scheme for the reconstruction of the tramways for electrical purposes. The length is over two miles, and the estimated cost of the reconstruction of the track, together with the provision of 10 passenger cars and the necessary plant, is £32,500.

Electric Railway Construction in Germany.—The *Society of Arts Journal* says that of the most important German cities, Aix la Chapelle, Brunswick, Chemnitz, Dresden, Hamburg, Hanover, Leipzig, Munich, and Stetten have almost completely abandoned horse cars, and are supplied by electric roads. In the cities of Berlin, Breslau, Cassel, Cologne, Frankfort-on-the-Main, Düsseldorf, Barmen, Elberfeld, Königsberg (East Prussia), and other places, horse lines are being converted into electric roads, and most of these have suburban electric roads completed. According to the

United States Consul at Düsseldorf, a large number of electric lines are being constructed in the country districts about Aix la Chapelle, Bochum, Gelsenkirchen, Düsseldorf, Vohwinkel, Elberfeld, Barmen, Elbthal, Essen, Krais, Hoerde, Reisengebirge, Waldenburg (Silesia), Witten-Ruhr, and in the mining districts of the Saar (southern Rheinland), and in Upper Silesia. In 35 cities and districts, not mentioned in the above lists, electric roads were in the course of construction on September 1st last, in nine of which the roads were completed and put into operation before the close of the year, so that at the beginning of the year 1899 there were 77 cities and districts in the empire supplied with electric roads. In 35 of these places extensions were being made to the lines in operation on September 1st, 1898, some of which were completed before January 1st. From a return which has been prepared on the subject, it appears that there were on September 1st last 888 miles of electric roads as compared with 595 miles at the corresponding date in 1897. There were in September last 3,190 motor cars as compared with 2,255 in 1897. Adding the roads put in operation since January 1st, 1899, it is estimated that there are now 930 miles of electric roads, with a total of 1,300 miles of tracks in Germany. From the city of Düsseldorf there are now four suburban electric lines completed. From Düsseldorf to Crefeld about 12 miles, from Düsseldorf to Rattigen about 8 miles, from Düsseldorf to Benrath about 6 miles, and from Düsseldorf to Kaiserwerth about 5 miles.

Electrical Omnibuses.—Whilst London has been promised and been expecting during the past year or two the arrival of a street service of electric omnibuses, the centre of promise now appears to have been transferred to Berlin, according to a *Financial Times* correspondent. The General Omnibus Company of that city has informed the municipal authorities that, in accordance with previous arrangements, a line of electric omnibuses will be experimentally placed on the streets during the present month in connection with the International Exhibition of Motor Cars, and that at the close of the exhibition the number of electric street cars will be increased. Suitable provision has been made for the recharging of the accumulators with which the omnibuses will be equipped, and the company hopes that the experiments will afford a practical test of the commercial value and prospects of electric omnibuses for the purpose of dealing with the passenger traffic of a large city like Berlin.

On Sunday last electric omnibuses were placed on the Berlin streets for public hire, the fare for about one mile being 20 pfennige (about 2d.). The speed is nowhere to exceed eight miles an hour. They are to run for the present in connection with a motor car exhibition, but should they prove a success the police are prepared to permit their general use.

Greenock.—The Law and Finance Committee of the Police Board conferred with a deputation from the Greenock and Port Glasgow Tramways Company last week, with a view to doing away with the deadlock in the negotiations with regard to the future working of the tramways and the adoption of electric traction.

Italy.—Ingegneri Arno & Caramagna is the style of a new firm which has just been formed in Turin, with a capital of £4,000, to introduce a new conduit system of electric traction.

Leeds.—The work required to be done before a service of electric cars can be permanently run between Boar Lane and Headingly is still unfinished, says the *Leeds Mercury*. In the early part of the year the members of the Tramways Committee thought that the cars would be running by the end of June or the beginning of July. They are still devoting their energies to pushing forward the work at the generating station. Only the engine and dynamos need completion; everything else is practically ready. Great efforts are being made by members of the Council to have the service in operation by November 1st. There are now 41 electric cars in the city. For the ordinary service between Kirkstall and Roundhay 21 are used, though at busy periods 30 are employed. By the time electric cars are required for the Headingley route, probably there will be another dozen motor-cars to hand. The tramway shed at Chapeltown is now being adapted for the accommodation of electric cars.

Liverpool.—Since the joint report of the city engineer, the city electrical engineer, and the general manager was issued in regard to a scheme of electric tramways for the whole city, the Tramways Committee have carefully considered the schedule of proposed new lines, with the result that 19 have been deleted out of the 42 proposed. The remaining lines, together with one or two additions not included in the report, will, says the *Liverpool Mercury*, come before the City Council at a special meeting to be held on Wednesday, October 4th, when the Council will have to consider, and if thought expedient, approve of a memorial to the Board of Trade for a provisional order for the construction of the proposed lines.

At Wednesday's meeting of the City Council the Tramways Committee asked for authority to reconstruct the lines for electric traction from Old Haymarket, along Victoria Street and North John Street to Lord Street, at an estimated cost of £4,284 for permanent way and paving, and £729 for overhead electric equipment.

Luton.—Mr. A. T. Snell has reported to the Corporation *re* electric traction. Notes are given of the Brussels system. The cost of the overhead wire system is given at £7,000 per mile and the conduit £11,000.

Newcastle.—The 14 tenders submitted for the boilers for the new tramway power station has been referred to the chairman of the Tramways Committee and the town clerk to report upon. Mr. Laws, the city engineer, advises the use of single-deck cars to accommodate 20 to 25 persons. The committee has agreed to this, but double-deckers will be also obtained for the Gosforth and Byker sections and to meet additional traffic. The engineer will report as to the cost of erecting car sheds. Mr. Charles Hopkinson has reported on the subject of lighting the thoroughfares with electricity. Arc lamps placed 40 yards apart on alternate sides of the main streets, and 80 yards apart in the outskirts, are recommended. Each lamp will cost £30, and the interest and redemption would amount to £5 15s. per lamp per annum. The cost of current would bring the cost per lamp per annum to £16 13s. 9d. There are at present 23 electric lamps in use at £42 per lamp, and the Electric Supply Company has offered to charge £18 per lamp if 100 are erected.

Sheffield.—On Monday the electric tramways, which are described elsewhere in this issue, were publicly inaugurated, the mayor setting the first car in motion. The guests numbering about 200, afterwards rode over the route in the new cars, subsequently inspecting the power station and sheds.

Staffordshire.—A Birmingham paper says that the British Electric Traction Company are proceeding with the reconstruction of the Dudley and Wolverhampton tramways, and their conversion to a 3 feet 6 inches gauge, the object being to assimilate it with that of the Dudley and Stourbridge and Kinver lines. The work will be pushed on vigorously, and it is hoped by the middle of next summer electric cars will be running on the Dudley and Wolverhampton line.

Sunderland-South Shields.—It is stated that the British Electric Traction Company proposes to connect Sunderland and South Shields, also Hebburn and Jarrow, with electric tramways.

Surrey.—The Highways and Bridges Committee of the Surrey County Council have prepared a memorandum for the consideration of the local authorities of Surrey, in the course of which they say that the fact "that the London County Council proposed to introduce light railways into Surrey and that extensive schemes for the county have been brought forward by other parties, have led this County Council to move in the matter, and to endeavour to secure in the interests of the county that a carefully-devised scheme, designed to meet the convenience of the inhabitants generally, shall be prepared for consideration and discussion as early as practicable. The first portion of the scheme will naturally deal with the districts more immediately adjoining the county of London, but eventually the requirements of the whole county must be considered; hence this invitation is made to all local authorities to express their views and to make proposals if they desire to do so, and communicate them to the Highways and Bridges Committee of this Council by October 20th."

Worcester.—The Streets and Electricity Committees reported to the Council on Tuesday regarding the application of the tramway company for the Council's co-operation in extending and improving the tramways. The company also proposes to construct light railways from the Cross to Kempsey and Red Hill. A deputation from the company had explained their proposals, and on the advice of the engineer consulted by the Committee, Mr. Waller, the deputation were asked to submit a draft agreement showing the best terms they could offer with reference to the price to be paid for electric current to be obtained from the Corporation for existing tramways and extensions and proposed light railways, and other details. After consideration of the reply of the company, the Committee passed a resolution that they would not advise the Council to consent to the Worcester Tramway Company's application for power to construct light railways in the city, but recommended the Council to oppose that application, and to take over the existing tramways at such time as was thought best, and to reconstruct them and to construct such additional tramways in the city as might be considered necessary, and to work the whole of the tramways. The company expressed disappointment at the recommendations of the Committee, which aimed at the defeat of the company's scheme, without making any definite alternative proposals. The project of the company had been to at once introduce into the city an improved electric system of tramways, and to extend similar advantages to all the principal suburbs and adjacent villages, the application for powers to construct light railways to Red Hill and Kempsey being preliminary only to further extensions for opening out the whole of the environs of Worcester. If the project was opposed by the Council, they would have to consider the necessity of advising the company to withdraw from the scheme altogether, and probably the much-needed light railways to places like Kempsey, Ombersley, Powick and Hallow would be wholly frustrated. It was not for them to express an opinion upon the wisdom or probability of the municipality embarking upon a speculative expenditure, the merely preliminary portion of which their advisers estimated at £73,000, which was not likely to fall short of £100,000, and from which the same advisers estimated a return of only £2,884 a year.

TELEGRAPH AND TELEPHONE NOTES.

Cables in the Pacific.—We make the following extract from an able article on "The New Pacific," which appeared in a recent issue of the *Saturday Review*:—"If Great Britain does not remain mistress of the Pacific as of other seas, the fault will be that of her sons under the Southern Cross. Federated Australia should count for at least as much as Japan; Canadian interests will be second only to those of the United States; British interests in China

are predominant, and the measures taken to protect them costly. From Hong Kong to Sydney, from Sydney to Vancouver, from Vancouver to Hong Kong, British interests eclipse all others. In a very large measure the future depends on the development of the spirit of unity between Australia and Canada under the fostering ægis of the mother country. The British Pacific cable will be both sound business in itself and an excellent sign and symbol of British solidarity. The United States will not probably be far behind with a cable from San Francisco to Hawaii and the Philippines. Neither Australia nor Canada is blind to the opportunities latent in the waters which at once unite and separate them. Of that they have given ample proof in the last few years in the starting of steamship lines, in their readiness to bear their share in the cost of constructing the proposed cable, and in their attitude on the subject of imperial defence. Australian federation is as momentous a fact in Pacific history as was the triumph of Japan in the war with China. Both events mean that new powers have arrived prepared to dispute with all comers for their respective rights. Australia a nation, however, will enjoy dignities, and must face responsibilities unknown to the individual colonies."

Continental Telephony.—It is stated that in consequence of the increased telephone traffic between Berlin and various places in Denmark, a new line will shortly be opened. Telephonic connection is now being established between Berlin and Warnemünde, whence a telegraph cable runs to Gjedser.

Dover Telephones.—The town officials are to report on the question of municipal telephony.

Harrow Telephone Service.—It is stated that the National Telephone Company has threatened to disconnect the Harrow subscribers from its system, in consequence of certain disagreements between itself and the Middlesex County Council regarding way-leave rentals.

The Pacific Cable.—A correspondent of the *Financial News* writes:—"Unlooked-for delay has arisen over the steps to be taken to secure the laying of the proposed cable across the Pacific to Australia. The Imperial Government and the Canadian and Australasian Colonies have come to terms, and the Colonial Legislatures are passing the necessary resolutions authorising their Governments to contribute to the cost. New South Wales is the only one that has not, though it is understood there is no fear as far as finance goes. Meanwhile the Colonial representatives in London appear to have got at loggerheads. On the committee to be set up Australasia has been allotted three representatives, Canada taking two seats and the Home Government three. New Zealand wants one of the three Australasian seats definitely allocated to her, because of her separate contribution and her geographical position. All the other Colonies are willing, with the exception of New South Wales, who is standing out for no 'earmarking' of any representation. In consequence of this, the whole matter of the representation has been referred to the Colonial Governments, and a couple of months, which could have been usefully spent in going into preliminary questions relating to cost of construction and maintenance, have been wasted. In fact, nothing has been done; and unless the Colonial Governments come to an understanding much quicker than their London representatives seem able to do, the question will have to be hung up for an even more indefinite period; for the Agents-General leave at the end of this month for America, to attend, at Philadelphia, the International Commercial Conference. Great irritation and annoyance exist in colonial circles over this delay."

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—Cable beyond Gurupa	April 4th, 1898	
La'akia-Cyprus	June 20th, 1899	
Accra-Grand Bassam	August 1st, 1899	
Corea-Japan	August 7th, 1899	
Cheik Saiid-Perim	Sept. 3rd, 1899	
Jamaica-Colon	June 30th, 1899	
Jamaica-Porto Rico (Ponce)	August 15th, 1899	
Cape Haitien-Puert o Plata	August 21st, 1899	August 31st, 1899
Cape Haitien-Mole St. Nicolas	August 21st, 1899	Sept. 1st, 1899
Landlines.		
Communication between Salonika and Monastir	March 23rd, 1899	
Communication between Bolama-Bissao	July 28th, 1899	
Puerto Plata-St. Domingo	August 23rd, 1899	Sept. 1st, 1899
Communication with Campeche and all offices beyond Yucatan (Mexico)	August 31st, 1899	Sept. 3rd, 1899
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, and Cape Haitien Port au Prince to Miribalais and Jacmel	August 18th, 1899	

Telegraphic Rates to South and Central Africa.—The *London Gazette* for last Tuesday states that on and after the 1st inst. the following rates will be charged for each word in telegrams to the undermentioned countries and territories in South and Central Africa:—Cape Colony, Natal, Orange Free State, Transvaal and Zululand, 4s.; British Central Africa (Nyassaland), 4s. 5d.; Portuguese East Africa—Beira, Fontesvilla, Ancoazi, Bandara, Candida, Chimara, Chinde, Chiromo, Iumbo, Macaze, Maquivalvilla, Masangona, Mbgurrumba, Mechure, Mhassenge, Mularara, Ntumbe, Pinda, Quaqua River, Quilimane, Singal, Tangalene, Tete and Vicente, 4s. 6d.; Swakopmund (German South-West Africa), 4s. 2d.; Northern Rhodesia, 4s. 5d.; and Southern Rhodesia, 4s. 6d.

Uganda Telegraphs.—In a note on the departure of Sir H. H. Johnston's expedition for Uganda last week, the *Times* says that direct communication between the Imperial Government and its representatives in Uganda is now a *fait accompli*. The telegraph line has in fact reached the shores of Victoria Nyanza. The wire is working admirably, and telegrams are now constantly being received at Downing Street from the acting Commissioner well within 24 hours of their despatch from Uganda.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos, switchboard, motor and trailer cars, trucks and electrical equipment, overhead equipment, underground feeders, conduits, road work, &c., for the Barking and Beckton light railways. See "Official Notices" September 1st.

Barnsley.—September 16th. Tenders are wanted for electric light wiring and fittings at the Harvey Institute, Eldon Street, for about 700 lights. See "Official Notices" August 18th.

Belfast.—September 31st. The Electric Committee wants tenders for c.i. floor plates and w.i. rails for the electric light department. Specifications from the city electrical engineer on payment of one guinea, returnable as usual.

Bermondsey.—September 13th. The Vestry wants tenders for electric lighting work at the Town Hall. See "Official Notices" September 1st.

Blackburn.—September 20th. The Corporation wants tenders for 40 electric cars and two 256-kw. steam dynamos. See "Official Notices" this week.

Carlisle.—September 11th. The Corporation wants tenders for extension to steam, drain, and feed pipes, feed pump, and extension of economiser at the electricity works. See "Official Notices" August 18th.

Carlisle.—September 18th. The Corporation wants tenders for extension of switchboard for dynamos 5 and 6, and for traction work. See "Official Notices" September 1st.

Darwen.—September 25th. The Corporation wants tenders for a high speed vertical engine and dynamo (300 to 350 kw.); also switch work. See "Official Notices" to-day.

East Ham.—September 9th. The Urban District Council wants tenders for combined electric light and traction plant, engines, generators, overhead line equipment, cars, switchboard, arc lamps, &c., water-tube boilers, condensers, and other steam plant, electric light cable. Mr. W. C. Ullmann, The Limes, White Post Lane, East Ham, is the Council's electrical engineer. See "Official Notices" August 4th.

Germany.—September 20th. Tenders are being invited until September 20th by the Cotton Wool Exchange authorities in Bremen for a complete installation of electric lighting in the new Exchange. Tenders are to be sent to Das Banbureau für die Bremer Baumvoll börse la Dechanatstrasse, Bremen, whence particulars may be obtained.

Germany.—October 16th. Tenders are being invited by the municipal lighting and tramway authorities of Königsberg, Prussia, until October 16th, for the supply of six boilers required in connection with the extension of the electric power station, to supply steam to new engines aggregating 1,800 e.h.p. Tenders to be sent to Die Direction der Städt, Belenchtungswerke und der Electr. Strassenbahnen Kaiserstrasse 41, Königsberg, Prussia, whence particulars may be obtained for 1s.

Glasgow.—October 10th. In connection with the tramway scheme the Corporation wants tenders for switchboards, fuel economisers, two 50 and one 30-ton electric travellers, power station steel work, and cables. See "Official Notices" to-day.

Hackney.—September 12th. The Vestry wants tenders for four sets of direct current steam dynamos (either high or low speed). See "Official Notices" August 11th.

Heckmondwike.—September 20th. The District Council wants tenders for the supply of water-tube boilers, economiser, pipe work, steam dynamos and motor boosters, accumulators, switchboard work, travelling crane, mains, arc lamps and posts, and station lighting. See "Official Notices" August 25th.

Ilfracombe.—September 25th. The District Council wants tenders for boiler plant, engine plant, dynamos, condensers, switchboard, mains, lamp-posts, accumulators, meters, crane, buildings, &c. See "Official Notices" August 18th.

Luton.—September 22nd. The Council wants tenders for boilers, superheaters, engines, dynamos, switchboard, steam and other piping, batteries, street conduits, boxes, feeders, arc lamps and posts, and various other plant and machinery for the electric lighting installation. See "Official Notices" August 25th.

Middleton.—September 20th. The Corporation wants tenders for Lancashire boilers, superheaters, economisers, steam pumps, condensers, steam dynamos, balancer and boosters, switchboard, accumulators, cables, crane, &c., for electricity works. See "Official Notices" September 1st.

Oldham.—The Electric Light Committee invites tenders for rolled steel girders, concreting, and other works required in the foundations for "Kleins Tower Water Cooler" at the electric light station, Gas Street, Oldham.

Rotherham.—October 9th. The Corporation wants tenders for Lancashire boilers, engines, dynamos, piping, condenser, economiser, battery, switchboard and boosters, feeders, mains, road work, &c., for electric lighting. For particulars see "Official Notices" this week.

Runcorn.—September 27th. The Urban Council is inviting offers for the electric lighting of the district, to be sent to the chairman of the Highways Committee.

Russia.—The municipal authorities of Perm are at present inviting tenders for the concession for the establishment and exploitation of a central electric lighting station in the town.

St. Annes-on-the-Sea.—September 11th. The Council wants tenders for high speed engines, continuous current dynamos, and balancing booster, for electric lighting. See "Official Notices" August 18th.

Salford.—September 12th. The Tramways Committee is inviting tenders for 100 tramcars. See "Official Notices" September 1st.

South Wales.—September 28th. The proprietors of Margam Copper Works, Port Talbot, wants tenders for the electric lighting (arc and incandescent) of their works. See "Official Notices" August 18th.

Sunderland.—The Corporation wants tenders for four 270-kw. three-crank direct current steam dynamos, and two surface condensers and cooling tower. See "Official Notices" August 18th.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warrington.—September 30th. The Committee of Visitors of the Winwick Asylum, near Warrington, invite tenders for Contract No. 1.—Generating plant, including three sets of condensing engines or turbines, with directly coupled dynamos, each of 100 kw. output at 220 volts, booster set, motors, surface condensers, cooling tower, steam and exhaust pipes, &c. Contract No. 2.—Switchboard. The drawings can be inspected and specifications obtained of J. P. Muspratt, Clerk to the Committee of Visitors, County Offices, Preston, on payment of £2 2s for each specification, returnable. A separate tender must be sent in for the work included in each specification. See "Official Notices" this week.

CLOSED.

Aberdeen.—The Council has accepted tenders for supplies in the electric lighting department as follows:—Electric meters, Messrs. S. Z. de Ferranti; service cables, British Insulated Wire Company; house fuse boxes, Alex. Spark (local).

Dundee.—The following are the contracts for the laying of the Lochee and Perth Road electric tramway lines:—Perth Road, other than rails and fixings, Messrs. J. & C. Hay, £9,652 1s. 6d.; Lochee Road, Mr. R Sheach, jun., £11,892 11s. 1d.; rails, points, and crossings for Lochee Road and Perth Road, Messrs. Dick, Kerr, and Co., Limited, £9,698 5s. 8d. For the electrical equipment of the two routes the tender has been given to Messrs. R. W. Blackwell and Co., London, whose price was £5,931 10s. 2d. The total for the whole work is thus £37,174 8s. 5d.

FORTHCOMING EVENTS.

Friday, September 8th, at 2 o'clock.—Meeting of the Brush Electrical Engineering Company at Cannon Street Hotel.

Wednesday, September 13th.—The meeting of the British Association for the Advancement of Science opens at Dover with the presidential address of Sir Michael Foster. The sectional proceedings continue until Wednesday, 20th inst. The papers already announced include the following:—"Recent Applications of Electro-Metallurgy to Mechanical Engineering," by Mr. Sherard Cowper-Coles; "Electrical Machinery on Board Ship," by Mr. A. Siemens; "Earth Currents from Electric Tramways," by Mr. J. Swinburne; "The Niclausse Boiler," by Mr. M. Robinson.

On Saturday, 16th inst., in Section A, there will be papers by Profs. J. J. Thomson and Oliver Lodge, with a special view to the visit of the French Association.

On Monday, September 18th, Prof. Fleming will lecture on "The Centenary of the Electric Current."

On Tuesday, September 19th, the Automobile Exhibition opens at the Athletic Ground, and continues until 21st. Also on the 19th inst. there will be a paper by Prof. Threlfall on his gravity metre, and a discussion on "Platinum Thermometry" will be introduced by Prof. Callendar and Drs. Chappuis and Harker. In Section F a paper is expected by Mr. R. Donald (editor of the *Municipal Journal*) on "Municipal Trading." On Friday, 15th inst., Mr. Parsons will read a paper on "Turbines for Fast Cross Channel Service," in Section G.

Monday, September 18th.—The National Electrical Congress opens at Como and continues until September 23rd.

Tuesday, September 19th, at 10.30 a.m. (also September 20th and 21st).—Tenth annual general meeting of the Institution of Mining Engineers at University College, Sheffield. Among the papers down for reading is one by Mr. S. F. Walker, on "Alternating Currents and their Possible Applications to Mining." Part I.

NOTES.

Examination Tests.—Moralists sometimes tell us that the sum of evil on earth is a constant quantity, and there are many happenings that give support to this contention. The adoption of the system of entrance by examination by the Institution of Civil Engineers appeared at one time to have added a distinct load to the sum of evil, but, after all, it was not to be. The counterbalance has come in the shape of a notice from the Lords of the Committee of Council on Education that they have under consideration the discontinuance of the examination test in assessing grants in the elementary stage of science and art, the discontinuance to date after the year 1900. If there be nothing else, surely this will mark the date as a real *fin de siècle*. To assess the efficiency of education by inspection has much to recommend it. Much depends on the inspector. Not too lightly to disturb the existing calm of grantees, there is reserved provision for examination of such as wish to be examined and certificated on payment of a certain fee. This reservation spells weakness. If the examination system be faulty, why not reform it altogether? Half-measures are useless.

Indian Water-Power Scheme.—An Indian paper publishes a despatch from Simla (August 16th), stating that the Government has sanctioned a deputation to Europe and America of Captain A. de Lotbeniere, R.E., deputy chief engineer, Mysore Public Works Department, for six months, in connection with the Mysore Government's scheme for utilising the power of the Cauvery Falls at Sivasamudram, for generating electricity with a view to supplying the power obtained to the Kolar gold fields.

A Spelter Combine.—The latest in combinations is a scheme for controlling the world's production of spelter. Although details of the scheme are not yet divulged, the *Standard* learns that a combination of spelter producers is forming, and an agreement has been already arrived at between the Silesian and Belgium firms interested. It now only remains for the negotiations with the American producers to be brought to a successful conclusion. Such negotiations are now proceeding.

The Glasgow Electrical Tramway Contract.—A telegram from Glasgow late last evening informs us the Council has decided that Messrs. Musgrave and the Allis Company shall each make two of the main engines, but that a new detailed specification is to be made for the auxiliary engines. This is, after all, probably the best course that could have been taken.

The Conductivity Method of Studying Moderately Dilute Solutions of Double Salts.—In the *Philosophical Magazine*, (V.), Vol. 45, pages 151—157, there is a paper by James G. MacGregor and E. H. Archibald on the calculation of the conductivity of aqueous solutions containing two with no common ion. According to the dissociation theory, the specific conductivity of a complex solution, volume v of which contains N_1, N_2, N_3, &c., gramme equivalents of the electrolytes 1, 2, 3, &c., respectively, is given by the expression—

$$\frac{1}{v}\left(\alpha_1 N_1 \mu \infty_1 + \alpha_2 N_2 \mu \infty_2 + \alpha_3 N_3 \mu \infty_3 + \&c.\right)$$

where the α's are the coefficients of ionisation of the electrolytes, and the $\mu \infty$'s their specific conductivities per gramme equivalent at infinite dilution. It is shown how equations sufficient for the determination of the α's and N's may be obtained for solutions containing two electrolytes with no common ion. A series of observations and calculations of the conductivity of solutions containing sodium and potassium chlorides and sulphates was made to test the results. The agreement between the observed and calculated values in the case of the more dilute solutions is satisfactory. There is a further paper by the same authors in the *Philosophical Magazine*, (V.), Vol. 46, pages 509—519. In the cases which they have investigated so far, the conductivity of solutions containing two electrolytes with a common ion is calculable by means of the dissociation theory up to a concentration of about 1 gramme equivalent per litre. The conductivity of solutions of the double sulphate of potassium and copper is similarly calculable only up to a concentration of about 0·1, and has at concentration 1 a considerably smaller value than that calculated on the assumption that no double molecules are present. The solutions of double salts have, at concentration unity, an appreciably smaller conductivity than the equivalent mixtures. The conductivities of mixtures, in molecular proportion, of solutions of zinc and copper sulphates, and of potassium and sodium sulphates, are calculable within the limits of observational error up to a concentration unity; and, therefore, the non-calculability in the case of the double salt solutions is probably not due to defective data. The differences between the observed and calculated values of the conductivity of the double salt solutions and of the equivalent mixtures, and between the observed values in these two sets of solutions, are such as would be accounted for by the presence of double molecules in both, and their presence in slightly greater number in the double salt solutions than in the equivalent mixtures.

The Institution of Electrical Engineers' Reunion in Switzerland.—Our representative writes:—"Up to the present the tour has been most successful and enjoyable, while at the same time it has embodied no small amount of real hard work. The only regrettable feature has been the unfortunate illness of Colonel Huber, who has done so much to facilitate the arrangements and render the reunion a success; Colonel Huber is seriously, but, we are happy to say, not dangerously ill, and is thereby debarred from taking part in the excursions and meetings. We trust that his recovery may be speedy and complete. The programme has been faithfully carried out as arranged, the members of the party having visited the magnificent power station at Rheinfelden, and the splendidly equipped works of Messrs. Brown, Boveri & Co., the Maschinenfabrik Oerlikon, and Messrs. Escher, Wyss & Co., besides various minor places of interest. Some disappointment having been occasioned by the visit to Messrs. Escher, Wyss and Co.'s works being alternative to that arranged for Messrs. Sulzer Bros., the energetic secretary of the Institution, Mr. W. G. McMillan, succeeded in arranging for an extra visit to the latter works to take place on the return journey from the Schaffhausen power station. On Tuesday a number of the members visited the Landes Museum in Zurich, which contains a most valuble collection of antiquities and objects of interest, while others, including several of the ladies of the party, inspected the Rüti Silk Weaving Factory. On Tuesday evening the members were entertained by the Schweizerischer Elektrotechnischer Verein and some Swiss firms to a banquet at the Tonhalle."

A New Calorimeter.—A new calorimeter for the testing of coal and other solid or liquid fuels is described in the *Street Railway Journal* as the invention of J. R. Chapman, of the North Chicago Street Railway Company. It consists of a water-sealed vessel, with an internal bomb, and suitable pipes for filling and emptying. At the top is an open glass tube, graduated, and 20 inches long. A funnel on a side stand pipe communicates to the bottom of the vessel. The bomb is closed by a plug screwed into its base, which is in one with the bore of the outer vessel. To use the apparatus this plug is removed, a given weight of fuel is placed in the bomb, and ignited by a platinum wire and battery. The outer vessel is filled with water until this stands at the zero mark in the glass tube. The whole is allowed to attain the temperature of the room; oxygen is passed into the bomb, and the fuel is ignited, when a given predetermined pressure has been attained, and temperature has become equable and uniform. Combustion is rapid, the bomb expands by heat, and forces water up the graduated tube, the maximum point being noted, and the differences of reading are observed between different fuels. There is no calculation necessary. Results are comparative and approximate alone, and obviously the rapidity of combustion will cause a variation of reading. Given a pure charcoal as a datum, it is probable that, as between one coal and another, there would not be serious difference in rapidity of combustion for a small sample, while the same may be said of different samples of liquid fuels. The use of more accurate instruments, such as Mahler's bomb, is debarred to the ordinary man, because of the necessity for special care and accuracy, and probably this new calorimeter, however far from absolute accuracy, and useless for an actual calorific evolution, will be sufficient for everyday comparisons. The difficulty with all fuel tests, other than those of liquid fuels, is, of course, the extreme difficulty in selecting a true sample.

Municipal Tramways of Neath.—The town of Neath has a tramway system, and has recently equipped it with gas motor cars on the system of the British Gas Traction Company, thus superseding the system of horse traction. In these days, when municipal authorities set every possible obstacle in the way of conveniences for ratepayers, whose servants they ought to be, it is satisfactory to find that the men who rule Neath have some ideas of progress. Gas traction may be a long way behind electric traction, but it is a long way better than the horse. There seems to be a good deal of unnecessary secrecy about this gas traction business, which we see referred to as the new system of the Gas Traction Company. We thought the system had been "perfected" long ago at Blackpool. Why this continued newness? It is nearly 20 years since a friend of ours considered a scheme for using gas engines on tramcars with vessels of compressed gas, but he went no further at the time as a patent was secured soon after by a Melbourne engineer on the same lines, and it did not seem advisable to pursue the matter to the length of a patent. How is it that to-day there can still be patents for gas traction? Does the British Gas Traction Company possess anything further than a gas engine worked by gas from a compressed charge—compressed only for convenience of carriage and arrangement on a car?

Magnetic "Lines of Force."—"E. R. P." writes to *Nature* as follows:—"In some text-books and by some lecturers (*e.g.* Prof. A. Gray, as reported in *Nature* of August 17th, p. 379), the lines of magnetic force are said to be the curves along which iron filings are marshalled when sifted over a piece of card laid over a horizontally placed magnet. Surely this is hardly correct. The true line of magnetic force must be represented, like those of all other radiant forces, by radiating straight lines drawn through the points of action of the resultants of all the forces residing in the individual molecules of a given magnet (such points, though varying in position with the position of a magnetic body in the field, being often referred to as fixed 'poles'). The symmetrical figures traced out by iron filings merely show, of course, the directions in which a line joining the poles of a very short magnet will lie in different parts of a magnetic field, under the influence of the true lines of force."

The Paris Electrical Congress of 1900.—With regard to the Electrical Congress of 1900, Mr. Howard J. Rogers, director of education and social economy of the United States Commission to the Paris Exposition, has issued the following memorandum, which we cull from the *Electrical World and Engineer*, of New York:—"The Universal Exposition of 1900 is sure to gather together in Paris a great number of the scientists and engineers of the whole world. This justifies the French electricians in their efforts to organise an International Electrical Congress, which has received the official patronage of the French Government. In previous conferences questions of units and nomenclature have been settled by international agreement, to the immense advantage of all concerned. During the last 20 years there have been unexpected discoveries, new applications of what seemed once to belong to pure science, and an extraordinary expansion of electrical industries. Practice has thus started up a great number of problems on which it will be interesting and profitable to have the views of technical authorities. The discussions of the Congress will, therefore, have especially an industrial and economical character. The work is, provisionally, divided as follows:—(1) Scientific methods and instruments of measurements; (2) production of electric energy, transformers, transfer and distribution, electric lighting, traction; (3) electro-chemistry, electro-metallurgy, accumulators, electric furnaces; (4) telegraphy, telephones, and various applications; (5) electro-physiology. The Congress will last one week, beginning Friday, August 18th. The subscription for membership is 20 francs.

Presentation.—On Friday evening last at the Alexandra Hotel, Dale Street, Liverpool, an interesting presentation of a silver tea and coffee service with an illuminated address, was made to Mr. P. H. Naftel, of the Liverpool Corporation Electric Supply Works on the occasion of his marriage. Mr. Alfred Clough (works manager) who occupied the chair in the unavoidable absence of Mr. A. B. Holmes, the city electrical engineer, referred in felicitous terms to the respect and esteem in which Mr. Naftel is held by the whole of the staff and employés, and to his 15 years connection with the Liverpool Electric Supply Works. Mr. B. H. Collins, in supporting the chairman's remarks, briefly epitomised the progress made as regards the supply of electrical energy in Liverpool since 1883, when 120 lamps only were connected to the mains whereas there were now 103,000 16-C.P. lamps supplied.

The Car Injured.—A River Plate contemporary recently had the following:—"In the Paseo de Julio the electric tram ran over an old lady and was badly injured." Doubtless the lady will pay heavy compensation with a light heart.

Personal.—We hear with regret that Mr. Sutherland, the electrical engineer at Worcester electricity works, has been compelled to tender his resignation owing to ill-health, and the Council has unanimously granted him leave of absence for 12 months. A *locum tenens* will be appointed at £250 per annum, and the balance, £100, will be paid to Mr. Sutherland to act as consulting engineer. The advertisement appears among our "Official Notices" to-day.

Mr. Arthur Wright has accepted the appointment of managing director of the River Plate Electric Light and Traction Company, Limited (78, Coleman Street, E.C.), and has, in consequence, arranged with the British Thomson-Houston Company, Limited, to terminate his engagement as their retained consulting engineer on electric lighting matters.

Appointments Vacant.—The vacant chair of Natural Philosophy at Glasgow University, which carries with it £1,000 a year and an official residence, is now being advertised. Applications have to be submitted by 15th inst.

The Sunderland Corporation wants a competent engineering assistant to act as clerk of works and inspector in connection with the electric tramway construction works. Salary £250. See "Official Notices" this week.

Experiments with Nickel Steel Tubes.—Some very instructive experiments have been made by Mr. Yarrow on tubes of nickel steel with a view to ascertain the unstability of the material for tubes in boilers. We need not give the results in great detail as given in Mr. Yarrow's paper before the Institution of Naval Architects, sufficient to say the alloy known as nickel steel contains 20 to 25 per cent. of nickel. The tests simulated the more severe action to which tubes are exposed in boilers. Comparison was made with tubes of mild steel. Exposed to a dilute solution of hydrochloric acid, the nickel steel had a waste of only one-sixteenth to one-seventeenth that of mild steel tubes. Exposed to fire under the same conditions, the nickel steel lost by oxidation less than one-third of what the mild steel tubes lost. Tubes were heated, and at the same time exposed internally to a slow current of steam, and under these conditions a nickel-steel tube lasted out two and one-third tubes of mild steel, indicating much less frequent need for re-tubing. The same experiment, but with a dull in place of a bright red, showed 2·8 times durability of nickel steel in one case and a double durability in another case. A mild steel tube repeatedly heated and cooled showed a *decrease* in length of $\frac{56}{64}$ inch, where a nickel-steel tube *lengthened* only $\frac{14}{64}$ in the same length of 42 inches. Nickel steel appears to expand by heat one-third more than mild steel, as shown by tests on tubes 22 inches long, 1 inch diameter, and No. 16 L.S.G. This should be taken as a warning not to use nickel tubes amongst others of mild steel, as an element of risk will be introduced by the differential expansion. The ductility of nickel steel is considered ample for ordinary purposes. It is also tougher to work than mild steel, and involves greater wear and tear of tools, &c. Nickel steel is costly, but perhaps not less than its durability warrants. Small percentages of nickel, as 5 per cent., give a greater durability than mild steel possesses, but not sufficient to be of practical value. The nickel must be present to an extent of 20 to 25 per cent.

Lord Kelvin.—Lord Kelvin, although retiring from the Chair of Natural Philosophy at Glasgow University after 53 years, hopes that the change will not imply loss of intercourse and association in scientific work.

Appointment.—Mr. E. T. Williams, of Manchester, has been appointed assistant electrical engineer at the King's Lynn Corporation Electricity Works.

NEW COMPANY REGISTERED.

Robert W. Blackwell & Co., Limited (63,446).—This company was registered on August 29th, with a capital of £200,000 in £1 shares, to carry on the business of electricians, suppliers of electricity, manufacturers of cables, wires, lines, accumulators, lamps, and electrical accessories, and apparatus of all kinds; railway and tramway proprietors, engineers, &c.; and to enter into an agreement with Robert W. Blackwell, Philip Dawson and Benjamin H. Howell, carrying on a business under the style of "Robert W. Blackwell and Co." The first subscribers (each with one share) are:—A. J. T. Barker, 9, Throgmorton Avenue, E.C., gentleman; P. Dawson, 39, Victoria Street, S.W., engineer; F. H. Barker, 9, Throgmorton Avenue, E.C.; C. Dickenson, 122, Cannon Street, E.C.; A. H. Barker, Warnford Court, E.C., gentleman; B. H. Howell, 27, Portman Square, W., engineer; R. Brown, 5A, Wisteria Road, Lewisham, S.E., engineer. The number of directors is not to be less than three nor more than five; the first are Robert W. Blackwell, Philip Dawson, Benjamin H. Howell, and Francis H. Barker; qualification, £1,000; remuneration, £200 each per annum.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Chili Telephone Company, Limited (29,252).—This company's annual return was filed on August 23rd, when 44,000 shares were taken up out of a capital of £250,000 in £5 shares. £5 per share has been paid; total, £220,000.

Langdon-Davies Electric Motor Company, Limited (55,830).—This company's annual return was filed on August 16th, when 8,500 preference and 44,007 ordinary shares were taken up out of a nominal capital of £70,000 in 20,000 preference and 50,000 ordinary shares of £1 each. £12,507 has been paid on 8,500 preference and 4,007 ordinary shares, and £40,000 is considered as paid on 40,000 ordinary.

Edmundson's Electricity Corporation, Limited (52,013).—This company's annual return was filed on August 16th, when 4,500 deferred and 26,100 ordinary shares were taken up out of a nominal capital of £200,000 in 4,500 deferred and 35,500 ordinary shares of £5 each; £5 has been called up on each of 17,400 ordinary shares, resulting in the receipt of £87,000; £66,000 is considered as paid on 8,700 ordinary and 4,500 deferred.

Edison & Swan United Electric Light Company, Limited (18,984).—This company's annual return was filed on August 18th, when 116,400 "A" and 23,564 "B" shares were taken up out of a capital of £1,000,000 in 150,000 "A" and 50,000 "B" shares of £5 each; 10s. has been called on each of 89,621 "A," resulting in the receipt of £44,630 10s.; £456,667 10s. is considered as paid on 139,964 shares (£3 on 10,000 "A," £2 10s. on 89,261 "A," and £5 on 17,139 "A" and 23,564 "B.")

CITY NOTES.

Stock Exchange Notices.—The Committee has appointed Thursday, September 14th, a special settling day in Edmundson's Electricity Corporation, £75,000 4½ per cent. first mortgage debenture stock, and Willans & Robinson, Limited, further issue of 10,000 ordinary shares of £5 each, £1 paid, Nos. 80,001 to 90,000, and 10,000 6 per cent. cumulative preference shares of £5 each, £1 paid, Nos. 60,001 to 70,000. The application to quote Imperial Tramways Company, Limited, 10,000 6 per cent. cumulative preference shares of £10 each, fully paid, Nos. 1 to 10,000; 20,000 ordinary shares of £10 each, fully paid, Nos. 1 to 20,000; and 200,000 4½ per cent. first mortgage debenture stock, has been refused.

Prospectus.—The prospectus of the Kalgoorlie Electric Power and Lighting Corporation, Limited, will be found in our advertisement pages. The capital is £250,000, of which £150,000 6 per cent. preference capital is offered for subscription until Wednesday next. This sum will be entirely employed as working capital. In the first instance plant of 4,000 H.P. capacity (continuous supply) is to be installed.

Davis & Timmins, Limited.—The directors announce a dividend on the preference shares for the period ended June 30th last at the rate of 6 per cent. per annum, payable on 15th inst.

Commercial Cable Company.—The board has declared a quarterly dividend of 1¾ per cent. on the capital stock, payable 2nd prox.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending September 2nd, 1899, were £1,471 7s. 2d.; receipts for week ending September 2nd, 1898, £978 15s. 3d.; aggregate for half-year to date, £18,462 5s. 5d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending September 1st, 1899, were £3,498 1s. 8d.; corresponding period 1898, £3,181 3s. 1d.; increase, £316 18s. 7d.

The City and South London Railway Company.—The receipts for the week ending September 3rd, 1899, were £891; week ending September 4th, 1898, £916; decrease, £25. Total receipts for half-year, 1899, £9,532; total receipts corresponding period, 1898, £9,611, decrease, £79. Miles open, 3¼.

The Dover Corporation Electric Tramways.—The receipts for the week ending September 2nd 1899, were £293 4s. 11d.; week ending September 3rd, 1898, £248 0s. 10d.; increase, £45 4s. 1d. Total receipts to date, 1899, £6,781 5s. 8d.; corresponding period, 1898, £5,505 10s. 7d.; increase, £1,275 15s. 1d. Miles of track open, 1899, 3; 1898, 3. Car miles run, 1899, 4,939; 1898, 3,771. Number of cars, 1899, 12; 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, September 1st, 1899, were as follows:—D. U. T. Co., horse cars, £1,831 12s. 6d.; ditto, electric cars, £1,746 11s. 5d.; D. S. D. Co., electric cars, £1,121 15s. 3d.; total, £4,699 19s. 1d.; corresponding week last year—D. U. T. Co., horse cars, £2,924 9s. 3d.; ditto, electric cars, £498 18s. 10d.; D. S. D. Co., electric cars, £1,124 15s. 8d.; total, £4,548 3s 9d.; increase, £151 15s. 4d. Aggregate to date, £42,723 8s. 8d.; aggregate to date last year, £41,184 11s. 2d.; increase to date, £1,588 17s. 6d. Worked:—The mileage open is 21 miles electrically, 23 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for two weeks ending September 2nd, 1899, were £1,531. Miles of track open, 10. Car miles run, 22,906. Number of cars, 21. The receipts for two weeks ending September 7th, 1898, were £590. Miles of track open, 5½. Car miles run, 7,570. Number of cars, 10. Increase, £941.

The Liverpool Overhead Railway Company.—The receipts for the week ending September 3rd, 1899, amounted to £1,994; corresponding week last year £1,617; increase, £377.

The South Staffordshire Tramways Company.—The receipts for week ending September 1st, 1899, were £747 17s. 8d.; aggregate receipts for 35 weeks, £23,118 8s. 8d.; week ending September 2nd, 1898, £629 1s. 9d.; aggregate receipts for 35 weeks, £21,918 7s. 8d.

STOCKS AND SHARES.

Wednesday Evening.

Politics is the dominating feature of the Stock Exchange for the time being, and even the most optimistic of House men have shaken their heads this week at the Transvaal developments. The public are showing very little disposition to buy anything at all, and, consequently, trade in the steady-going electrical market is reduced to a minimum. The dealers stand idle in the market place all the day long, and admit that they see small chance of a general revival until the South African *impasse* has been broken, one way or the other. The telegraph section is naturally affected by the same cause, and in traction descriptions there is hardly a change to record.

In the electrical supply market the most noticeable alteration is in a name, not a quotation. The House-to-House Electric has been turned into the Brompton and Kensington Electricity Supply Company, but the old shares retain their place for the time being in the official lists, and no change is marked in the price. Edmundson's shares are quoted ex rights, and we understand that the new issue was fully subscribed. The price, however, remains unaltered. Of the metropolitan companies, City of London alone are being dealt in to any extent, but in these the daily bargains booked now are far short of the number done a month ago. Nothing has yet been announced with regard to a new issue of capital by the Charing Cross Company—in fact, there is even some doubt expressed in the Stock Exchange as to whether the company will avail itself of the right to enter the City, at any rate, for some considerable period. It is quite certain that a heavy emission of fresh capital to-day would meet with a very poor response, owing to the general caution that prevails.

Beyond the quoting of a few bonds ex dividend, the telegraph market is almost unchanged. Eastern Ordinary has given way, as it naturally would do upon growing fears of a war with the Krugerian band, but Eastern Extensions hold their ground with remarkable pertinacity. It is a matter of opinion as to whether the actual outbreak of hostilities would not be an excellent thing for the two Eastern companies, and hardy investors are picking up cheap stock when it comes into the market. Operators in Anglo-American telegraph stocks are resting upon their oars—the phrase, perhaps, applies literally, having regard to the empty appearance of the market in the Stock Exchange. There is very little to "go for," as the House says, and prices change too slowly for the average speculator to be tempted into dealing.

Electrical railway securities are lifeless. Central London Preferred half-shares are now £5 paid, but there is no business doing in them. "I dealt in Central Londons yesterday," quoth one of the principal jobbers to-day, "and it was the first bargain I had done in them for a week." Waterloo and City has not regained the point it lost last week. The price of City and South London has hardly moved for the past month.

We believe we are correct in stating that important negotiations are on foot for the absorption of the Birmingham Omnibus Company by the British Electric Traction, but no details have reached us at present. The British Electric should be able to acquire the 'Bus Company cheaply, and the bargain would probably turn out well. No change has taken place in the price of the shares. Calcutta Tramways show a slight tendency to react after their rapid advance, but there is a small buyer in the market at 9. Considering that some little time may elapse before the company is likely to reap any practical benefit from the electrifying of its line, we should imagine that holders whose shares show them a profit might do worse than take it.

The Tramways Union Company announces that it has now sufficient money in hand to pay off the debentures in full, to return the capital to shareholders (*i.e.*, at the rate of £5 per share), and to add another 30s. per share thereto. Subsequent distributions will be made as its assets are realised, and the market is hoping that these will amount to at least a further £2 10s. per share. The price is now 8½—9. Barcelona Trams are 11—13, and Bordeaux keep steady at 12—14.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years.			Closing Quotation, August 30th.	Closing Quotation, September 6th.	Business done during week ended September 6th, 1899.	
			1896.	1897.	1898.			Highest.	Lowest
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	63 — 66	63 — 66	64	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	115 —116	115 —116	115⅞	115
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	14½— 15	14½— 15	14 15/16	14⅝
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15½	15
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105⅛	104
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	¼— ¼	¼— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,009	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½%	3½%	11⅞— 12¼	11⅞— 12¼	12⅛	12 1/16
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	153 —158	151 —156	155	152½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	99⅜	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	116 —121	116 —121	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15	14½— 14⅜	14⅝	14¼
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	115 —120	115 —120	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
800,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	103¼	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	104¼	...
180,227	Globe Telegraph and Trust	10	4½ %	4½%	5½%	10⅜— 11¼	10⅜— 11¼	11 1/16	10⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15 — 15½	15¼	15
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	...	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	49	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	106 —109 xd	106	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ⅜	¼— ⅜	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	5¼— 5½	5⅛— 5⅜	5⅜	5 3/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5½	...	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100⅜	100
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	130½	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,738£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	98 —101 xd	100½	98½
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— 1	¼— 1	⅜	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	105	...
88,321	West India and Panama Telegraph	10	1 %	⅜%	...	1⅜— 1⅝	1⅜— 1⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10¼— 10⅜	10¼— 10⅜	10¼	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8¼— 9½	8¼— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	105	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	98 —103 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10½— 11½	10½— 11½	10⅝	...
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6¼	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	113 —115	113 —115	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11½— 12½	11½— 12½	12 1/16	11⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13½	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	128¾	128½
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13½— 14½	13½— 14½	...	...
220,000	Do. 4½ % Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	81 — 84	82 — 85	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5 — 5½	5 — 5½	5 1/16	5¼
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8 — 9	8 — 9	8¼	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	6⅝	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15⅜	15¼
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14½— 15½xd	14½— 15½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16½— 17½	16½— 17½	17⅛	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4⅛	3⅞— 4⅛	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15½—16½	15½— 16½	15 1/16	15 3/16

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
§ Dividends paid in deferred share warrants, profits being used as capital

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Aug. 30th.	Closing Quotation Sept. 6th.	Business done during week ended Sept. 6th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3 — 3½	2¾ — 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	97 —102	97 —102	...	...
30,000	British Electric Traction	10	...	...	6 %	17½ — 18½	17½ — 18½	8 1/16	18
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13¾ — 14¼	13¾ — 14¼	14	13¾
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	...	...	...	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	129½	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	2 1/16	2
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6¼ — 6⅝	6¼ — 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞ — 2⅛	1⅞ — 2⅛	2	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛ — 2⅜	2⅛ — 2⅜	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	108 —112 xd	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½ — 14½	13½ — 14½	14¼	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼ — 10⅜	10¼ — 10⅜	...	...
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	2⅜ — 3¼	4⅜ — 5¼	5 1/16	5
71,447	Do. do. Def. do.	5	...	...	...	5¼ — 5⅜	5¼ — 5⅜	...	...
630,000£	City and South London Railway	Stock	1 2/16 %	1⅜ %	2⅛ %	65 — 67	65 — 67	66½	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼ — 6⅜	6¼ — 6⅜	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½ — 4	3½ — 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	6 %	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	6 %	4 — 5	4 — 5	4⅜	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2½ — 2⅝	2½ — 2⅝	2 1/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝ — ¾	⅝ — ¾	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	25 — 26	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	20 — 22	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅝	21¼
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	103¼	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3¼ %	3½ %	7⅜ — 7¾	7⅞ — 8	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13 — 13¼	13¼ — 13¾	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	38 — 42	...	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	104¾	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼ — 9⅜	9¼ — 9⅜	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝ — 6¼	5⅝ — 6¼	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	102½	102

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8½—9½.
British Aluminium, Ordinary, 9½—10; 7 % Pref., 10—11.
House-to-House, 4½% Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 2—4.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—7¾. Debentures, 105—108. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 19.

Bank rate of discount 3½ per cent. (July 13th, 1899).

MARKET QUOTATIONS, Wednesday, September 6th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a " Nitric	per cwt.	22/-	22/-	..
a " Oxalic	per cwt.	32/-	32/-	..
a " Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	35/-	35/-	..
a Ammonia, Muriate (crystal) ..	per ton	£25	£25	..
a " "	per ton	£23	£23	..
a Bleaching powder	per ton	£5 15	£5 15	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a " (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£23 10	£25	£1 10 dec.
a Lead, Nitrate	per ton	£23 10	£23 10	..
a " White Sugar	per ton	£31	£31	..
a " Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3¾d.	3¾d.	..
a " Caustic (75/80 %) ..	per ton	£24	£24	..
a " Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a " Recovered	per ton	£5 10	£5 10	..
a " Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£7 10	£7 10	..
a " Crystals	per ton	£3	£3	..
a " Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b " Sheet, in ton lots..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis	per lb.	8½d.	8½d.	..
c " Tube (brazed)	per lb.	10½d.	10½d.	..
c " Wire, basis	per lb.	..	8½d.	..

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
f Ebonite Rod	per lb.	8/-	8/-	..
f " Sheet	per lb.	5/-	5/-	..
g Copper Bars	per ton	£88	£88	..
g " Wire (basis price) ..	per lb.	10½d.	10½d.	..
g " Sheet	per ton	£88	£88	..
g " Rod	per ton	£88	£88	..
m German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	6/-	6/-	..
h India-rubber, Para fine ..	per lb.	4/2 to 4/3½	4/3	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i " Pig (Cleveland warrants)	per ton	67/6	64/9	2/9 inc.
i " Forgings, according to size	per ton	From £11	From £11	..
i " Scrap, heavy	per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 ..	per ton	£12 17 6	£12 17 6	..
g Lead, English Ingot	per ton	£14 18 9	£14 18 9	..
g " " Sheet	per ton	£15 7 6	£15 7 6	..
w Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£8 12	£8 12	..
d Mica (in original cases), small	per lb.	2d. to 6d.	1½d. to 6d.	..
d " " " medium	per lb.	1/9 to 2/6	1/9 to 2/6	..
d " " " large	per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd strip & sheet	per lb.	From 1/2½	From 1/3½	..
o Platinum	per oz.	£3 10	£3 10	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£146 10	£146 10	..
g " foil	per lb.	1/6	1/6	..
n " wire Nos. 1 to 16	per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles	per lb.	7½d.	7½d.	..
j " Best Flax, 6 lea. ..	per lb.	4½d.	4½d.	½d. inc.
j " Hemp, 3 ply 10 lbs. ..	per lb.	3½d.	3½d.	..
j " " Russian, 10 lbs.	per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove ..	per ton	£13	£12 10	10s. inc.
j " Manila, 24 thread ..	per ton	£35 10	£35	10s. inc.
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£27	£27 10	10s. dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
w Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

SOME FORMS OF MAGNETIC SEPARATORS, AND THEIR APPLICATION TO DIFFERENT ORES.*

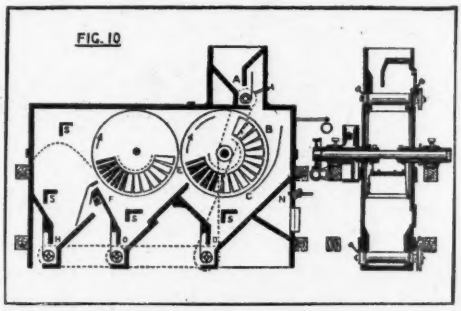
By H. C. McNEILL, Assoc.R.S.M.

(*Concluded from page 375.*)

2. The Monarch Separator.

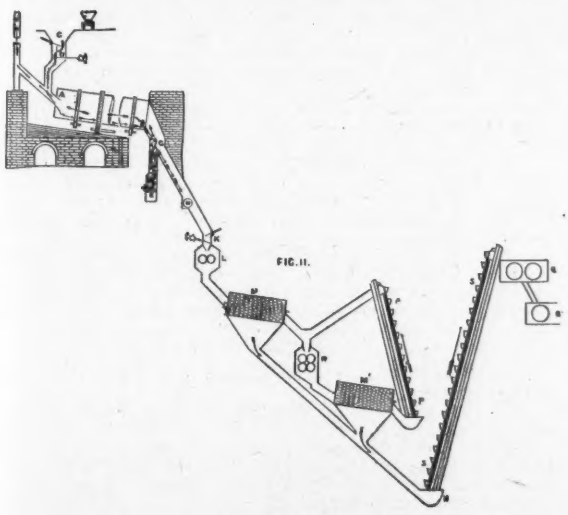
The Monarch separator may be regarded as a Wenström with the single drum duplicated; it is, however, of a rather more delicate construction, and is a modification of and improvement on the original Ball and Norton machine, a class which includes the most successful machines of the eccentrically placed internal electro-magnet and the revolving drum pattern. Fig. 10 shows a sectional elevation of this separator. It is necessary that the ore treated should be quite dry, and in both cases where the author was enabled to see the machine at work in Sweden the best results have been obtained upon material crushed to pass through a 1 millimetre screen.

The ore of the size mentioned, after drying, is fed in an even stream into the machine by means of the roller at A, the feed being capable of adjustment as shown. The mineral falls on the revolving drum, B, which moves over the fixed electro-magnets, all the material being compelled to pass close to the drum by means of the bent shield, B C. Having passed the point, C, the non-magnetic portion, or tailings, fall into compartment D, and are fed out at that point by a similar roller. At or near the point E the particles hop across to the next drum in consequence of a stronger current being employed in drum No. 2, and are possibly helped by an induced current of air caused by the superior velocity of this second drum, the relative speeds being as



6:1. Those particles containing a little magnetite are whirled off drum No. 2 at about the point F, the centrifugal force being the stronger force of the two, and drop into the compartment, G, constituting "middles" or "middlings." The wholly magnetic particles are whirled off drum No. 2, at about the end of the electro-magnets, and are flung against the end of the machine, and are fed out at H.

The "middles" may be re-crushed and re-treated, if necessary. A combination of three such machines, where the middles from two of



them are passed through a third, is said to be capable of treating 200 tons of uncleaned ore per day of 24 hours.

One of the later improvements on this separator is the introduction of drums made of German silver, which has been found to increase the efficiency of the machine.

This form of machine, when used after a careful preliminary treatment, such as drying, crushing, screening, &c., is applicable to two classes of ore:—

1. Those in which magnetite is more or less intimately associated with worthless material.

2. And those in which the magnetic portion is of secondary importance.

To both of which cases the machine is successfully applied.

The extensive plant seen by some of the members of this Institute whilst at Lulea, in the north of Sweden, last summer, may be taken as a case coming under the second of these conditions, and which may be briefly described as follows:—

The ore which is put through the mill assays from 0·01 per cent. to 3 per cent. phosphorus, and is correspondingly low in iron, the phosphorus occurring in the form of apatite. Only the ore richest in the latter mineral, and hand-selected on this account, is put through the mill.

It is first put through a Blake crusher and then through a single pair of Swenson rolls, the ore being thus reduced so as to pass through a ½-inch mesh screen. This product is then thoroughly dried by passing it through the revolving cylinder, A B, fig. 11. This cylinder is 48 feet in length and 4 feet 8 inches diameter; it is inclined 1 in 18, and rotates once every five seconds. The ore from the hopper, C, is by means of the feed-plates at D, passed in a constant stream into the cylinder, meeting the heated gases, &c., coming from the coal-fire at E. Having arrived at B, the ore, which is now quite dry and hot, falls down shoot G, being divided at that point into two streams (fig. 11A), in order to miss the uptake from the fireplace, E. At H is a revolving drum, and at K are placed an adjustable baffle-plate and a vibrating feed-tray, which not only acts as a safety catch to prevent

Fig. 11A.

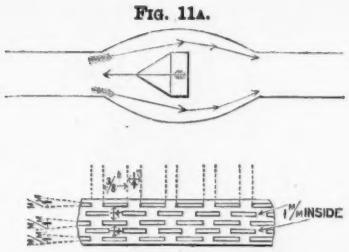
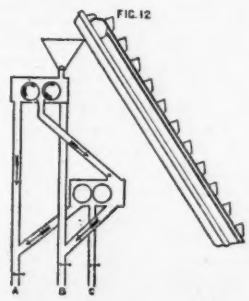


Fig. 11B.

any object, such as a hammer-head, getting into the rolls, but also regulates the feed of ore, so that the rolls, L, have just sufficient ore to deal with, and do not get clogged up. After passing these rolls the ore enters the circular screen, M. This screen is of $\frac{1}{16}$th inch thick steel plate with oblong holes, the details of which are given in the sketch (fig. 11B). A certain proportion of the ore, about 20 per cent. of the whole, which finds its way, or is small enough to pass through M, drops right down to the bottom chamber, N, whilst the rest passes out of the screen, and is fed into the double rolls, R, and after that passes into a second and similar screen, M¹. The ore fine enough to pass through this second screen joins that which has already passed through the upper trommel, M, whilst that which is still too large is returned to the double rolls, R, by means of the elevator, P P, and is re-crushed. Assuming the chamber, N, to contain nothing but ore 1 millimetre diameter, this is then transferred to a Monarch separator, Q, by the elevator, S S, the "middlings" from which pass down, and are sent through a second separator, Q¹.

The plant is in duplicate, *i.e.*, fig. 11 represents just one-half of the mill, each half working independently of the other half, and there are, therefore, four separators at work, two to each half.

The arrangement made for joining the like products from two separators is shown in fig. 12, where the two concentrates join



together and are collected at A, and the tailings similarly at B, whilst the "middles" from the top machine are taken to the lower separator, and the "middles" from which again collected at C.

All the screens, rolls, separators, elevators, shoots, &c., are boxed in with wood, and the dust from them, by means of mains and exhaust fans, drawn to a separate house, allowed to settle, and removed when necessary for further treatment.

* Read before the Iron and Steel Institute at Manchester, August, 1899.

It might be of interest to note that the tailings, consisting of apatite, with a very small proportion of magnetite and some hæmatite, constitutes the most valuable product delivered from the separators.

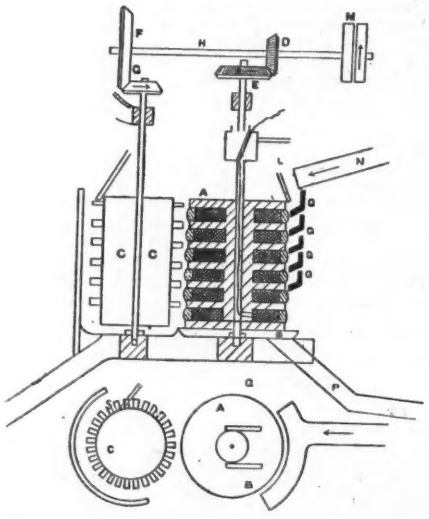
This then goes forward and receives further treatment for the separation of the small residual portions of iron compounds, and the finished phosphate of lime is finally converted into the soluble phosphate of soda by the Wiborgh process.

A similar plant to the one just described is also used, as already mentioned, where magnetite has to be separated from other and worthless minerals. In this case, the only point that it is necessary to draw attention to is that the ore itself, in the absence of any appreciable quantity of apatite, may be harder, and the initial crushing more difficult to accomplish. At Herräng a No. 5 Gates crusher is employed for this purpose.

3. The Dellvik-Gröndal Separator.

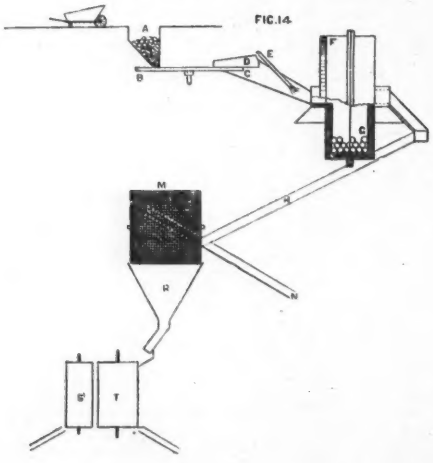
This machine is designed to treat those ores in which the magnetite exists in a state of intimate admixture with other and in general worthless minerals. At present it is at work, and is successfully treating low-grade magnetite ores. The preparation that the ore has to undergo before it is passed to this form of separator will be described when dealing with a plant now working at Bagga, in Sweden. For present purposes, the material may be described as a slime. Fig. 13 shows a sectional elevation and part plan of the machine. A B is of cast-iron, and consists of a series of rings. In the spaces between each of two is placed the copper wire conveying an electric current. This drum is rotated by means of the bevel gearing, D E, and the pulley-shaft, H.

FIG. 13.



C C is a solid drum of wood caused to revolve three times faster than A B by means of the gearing shown at F G, and is studded with soft wrought-iron bolts or pegs, each ring of which revolves exactly opposite to the rings on A B. It will be noted, as indicated by the arrows, that A B revolves from right to left in front, and C C from left to right in front. The slime is carried to the machine by means of the launder, N, which terminates in the circular launders, Q Q Q Q, which enclose the drum, A B, for about one-third of its circumference, as seen in plan, and offer a larger area of the slime to be acted upon. Further water is supplied by the pipe, L. The magnetic particles thus brought under magnetic influence attach themselves to the rings on A B, and are carried round. Those particles which escape the first ring are caught lower down, and so on, each successive ring being more strongly magnetic than the one above. The unmagnetic portion of the ore, being unattracted, is washed down and into launder P, together with the excess water. As each peg of the drum C C is successively presented to the rings of the drum A B, magnetism is induced therein, and the magnetite hops over and forms in tufts on each peg, and is thus carried out of the magnetic field, where most drops away, and the rest is washed off by a strong jet of water from the pipe shown, this separated magnetite being run by the launder into settling pits, from which it is dug out.

FIG. 14.



The copper wires conveying the electric current are protected by carefully fitted brass rings and special jointing.

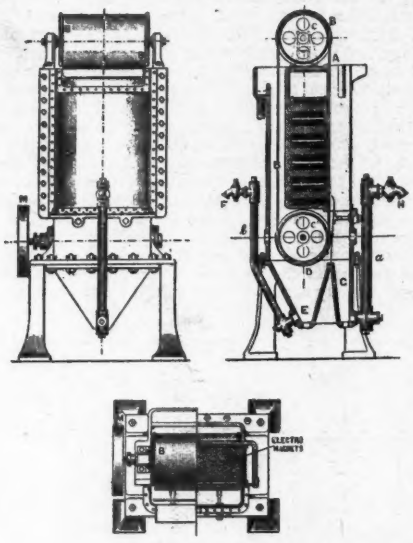


FIG. 15.

The necessary fine crushing before treatment in the separator is accomplished by means of a ball-mill. Fig. 14 is an attempt to show a small plant designed for the purpose of treating a low-grade ore, in which it is necessary that crushing should be carried to such a point that all the material shall pass through a 12-mesh screen. The first coarse crushing is done by means of a Blake machine, which reduces all the ore to about walnut size, after which it is passed through a ball-mill, a feature of which is an ingenious arrangement, by which a regular feed of ore is supplied to the mill. B C is a horizontal circular revolving plate, the height of which can be adjusted so that the distance between the bottom of the hopper, A, and the moving plate, B C, can be so regulated that just sufficient ore is allowed to drop through, and is carried round on the plate. D is a fixed guide-plate, under which the plate, B C, revolves, and the ore, in coming up against it, is slowly pushed off and into the shoot leading to the ball-mill F G. This is of cast-iron, lined internally with chilled plates, the latter removable, and is caused to rotate 40 times per minute upon hollow trunnions, through which ore is fed in on one side and out on the other, water being supplied by pipe E. Coarse slime is thus produced, and passes out with the excess water down an open launder H, and into a revolving screen M, of wire gauze, with 140 holes to the square inch. The stuff, already fine enough to pass through, drops into the shoot R, and is treated in the Dellvik-Gröndal separator S T, whilst that not sufficiently fine is carried up on the gauze inside, and drops from the top on to the enlarged end of a launder N, and is returned to the mill by a small pump.

Prof. G. Nordenström, in a paper read before this Institute at the Stockholm meeting last August, mentions the fact "that the Dellvik-Gröndal separator has been advantageously used at Pitkaranta, in Russian Finland, since 1894, for concentrating poor iron ores."

4. The Heberle Separator.

There are two distinct types of machine, each of which is shown in separate figures.

Fig. 15 is a type designed for the separation and concentration of low-grade magnetic ores only.

Fig. 16 is designed for the treatment of galena blende ores when occurring with magnetic oxide of iron; also the separation of roasted spathic iron and blende, &c., or in the treatment, which will be described below, of a complex ore consisting of galena blende, magnetic oxide, pyrrhotine, and quartz.

In fig. 15, the ore to be treated, after reduction to size of about 30-mesh, is fed in at A with water. B B is a continuous gutta-percha belt travelling round the pulleys C C, and over the fixed electro-magnets placed in the casing shown, the whole machine being enclosed in a wooden box, which is kept full of water to a height a little above the highest of the magnets. The magnetic portion of the ore attaches itself to the belt, and is carried down with it until,

arriving at D, and out of the field, falls away into E, and is withdrawn through F. The worthless portion falls into G, and is withdrawn through pipe H. The width of the belt may be from 1 foot 8 inches to 2 feet 6 inches, and a machine of the latter size is capable of treating 35 tons of crude ore per day. These separators may with

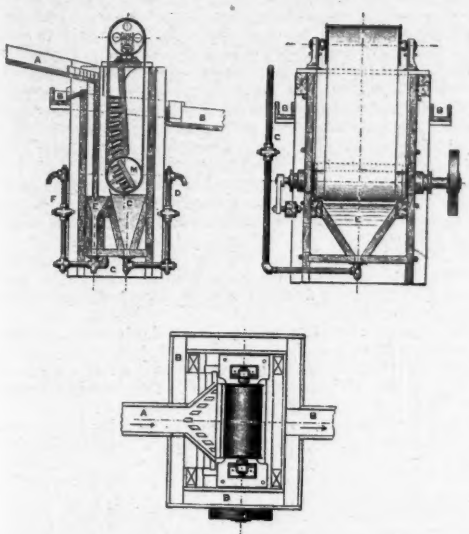


FIG. 16.

advantage be used in series where a favourable percentage of the magnetic iron might be obtained from the ore by a primary crushing of from 6 to 3 millimetres and treatment in separator No. 1, Fig. 17, the rejected portion being further reduced in size to, say, 3 to 2

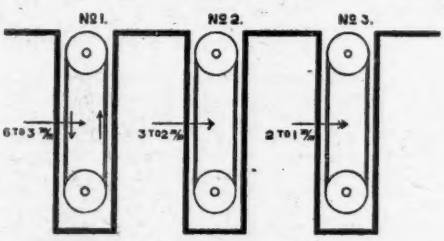


FIG. 17

millimetres, and treated in No. 2 separator, and so on with intermediate crushing between two such separators.

At Saxburget, in Sweden, where, by the kindness of Mr. Wenström, I was permitted to see their mill, they were treating an ore consisting of approximately—

	Per cent.
Lead	11
Zinc	22
Magnetic oxide...	14
Pyrrhotine (magnetic pyrites), Fe_8S_7 ...	2 to 5
Silica	15 to 20

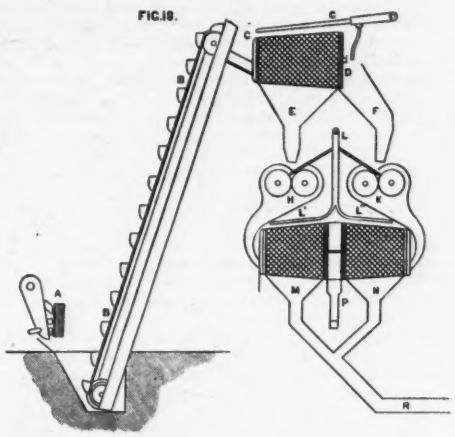
which is obtained from the adjacent Langfallsgrufvan mine.

The ore is first hand-cobbed and picked over to roughly pieces of 6 inches diameter. It is then passed on a Blake breaker, A, fig. 18, which reduces it to the size of about $\frac{3}{4}$ inch diameter. It is then lifted into the trommel, C D, provided with $\frac{3}{8}$-inch holes, by means of which the material less than $\frac{3}{8}$ inch passes through and goes on the fine rolls, H, together with water supplied by the pipe, G. Material larger than $\frac{3}{8}$ inch, or between $\frac{3}{8}$ inch and $\frac{3}{4}$ inch, passes down F to the coarse rolls, K; also with water supplied by the pipe shown. From these rolls the crushed ore passes to further trommels, M and N, provided with holes of about $\frac{1}{32}$ inch. The stuff already small enough passing down in the shape of a slime by launder B, direct to a Heberle separator of type shown in fig. 16, anything above $\frac{1}{32}$ inch is returned from P to the fine rolls, H, and re-crushed. The ore now consists of a slime containing all the minerals mentioned above, and in this state is run into the separator, fig. 16, at A. The magnetic portion is carried down on the belt and deposited into chamber C, and withdrawn by a pump through D. The coarser portion of the remainder of the mixture accumulates in E, and is withdrawn through the pipe, F, the outer case of the separator being kept full of water up to launder B by means of the water pipe, G, the finer portions of mixture consisting mostly of the blende and silica, together with about 3 per cent. magnetite, in a state of suspension, are carried away by the overflow, B, to setting pits for subsequent re-treatment as fine slimes.

The magnetite, after withdrawal from C, here disappears from the process, as, although it contains a little zinc and lead, it is found unprofitable to treat it further.

The material which collects in chamber E then goes forward to a four-compartment jig, whereby the coarser galena becomes separated and sized product and the other products are re-ground in a special form of mill designed by Heberle, and shown in fig. 19, and consisting of two fluted plates rotating concentrically against each other, after which as much as possible of the other minerals are separated by means of pointed boxes, continuous revolving buddles, and Rittinger side recoil tables, &c.

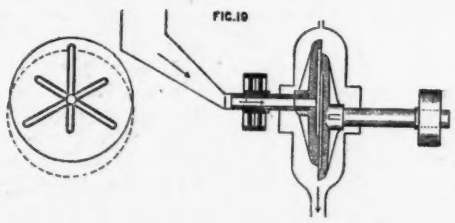
FIG. 18.



5. The Wetherill Machine.

This machine has been designed to treat the ores met with at the Franklin Mines, New Jersey, U.S.A., which contain Franklinite (the chief iron and manganese bearing mineral) intimately mixed with zinc oxide and Willemite (zinc silicate) in a limestone matrix. The problem was to utilise the natural and slightly magnetic properties of the Franklinite, separate it from the admixture of the other ores, and so concentrate the zinc minerals sufficiently high to admit of their

FIG. 19



reduction in the Belgian spelter furnaces. The original treatment was to roast the ore with anthracite, so increasing the magnetic properties of the Franklinite, and to treat the roasted product on a Wenström separator. Mr. J. P. Wetherill found on experiment that, by concentrating his magnetic field, the Franklinite, described by Dana as slightly magnetic, could be separated without preliminary roasting.

There are two types of Wetherill separator for treatment of ores of different grades.

Messrs. H. A. J. Wilkins and B. H. C. Nitze, in a paper read before the American Institute of Mining Engineers at the Pittsburg meeting, February 1896, gave sketches and some detail of these machines, from which it appears that the crushed and dry ore is subjected to the selective action of a highly concentrated magnetic field.

The author has had no experience with this type of machine, but there is little doubt that, in the treatment of complex ores, many of which consists of minerals described as "feebly" or "slightly" magnetic, considerable possibilities are opened up in the direction originated by Wetherill.

Messrs. Wilkins and Nitze mention "That amongst the minerals which have been found susceptible of attraction by the condensed magnetic power of these machines may be mentioned red and brown hæmatite, siderite, chromite, menaccamite, rutile, Franklinite, pyrolusite, &c. In fact, almost all minerals containing iron or manganese, or both, also salts of iron, manganese, and chromium; and with the introduction of still higher magnetic powers, it is hoped that even iron pyrites will come within the scope of successful separation treatment."

In conclusion, attention may be drawn to the increasing utilisation of magnetic iron ore, not only in this country, but to a still greater extent on the Continent, and to the growing importance of magnetic concentration as a branch of technical industry. There is undoubtedly a large field open both to the inventor and for the remunerative employment of capital, and the author hopes that these notes, as describing more particularly the Swedish practice, may not have been without interest.

THE SYNCHRONISING OF ALTERNATORS.*

By M. GARDNER and R. P. HOWGRAVE-GRAHAM.

The authors do not, in this paper, propose to deal with the manifold practical difficulties arising in the synchronising of alternators, as most of them are purely mechanical, or dependent on the individual skill and care of the switchboard attendant who is told off to perform this rather difficult and skilled operation.

This paper, then, is on the actual apparatus and methods of connection used in the synchronising of alternators, though we must first, to make the subject clearer, touch upon some of the more important points in the parallel running of alternators.

When coupling alternators so that their outputs may be combined, the conditions to be fulfilled differ in most respects from those in the case of continuous current machines.

Three conditions must be fulfilled that alternators may be run in parallel.

1. The machines must be in synchronism, that is, they must be running at such speeds that their frequency is the same.

2. They must be in phase or in step, which means that they must all give a maximum electromotive force of the same sign to the same bus bar at the same moment.

3. The voltage in most cases should be the same, but this condition is the least important of the three. In fact, the excitation of one machine is sometimes deliberately lowered to throw more load on to the others.

It is stated above that three conditions must be fulfilled that alternators may be run in parallel. The running of alternators in series was not considered, for the simple reason that alternators cannot be run in series.

It is well, perhaps, to just give a few words of explanation of this rather curious and inconvenient impossibility. We must first assume that we have got two alternators designed to give equal electromotive forces at a fixed frequency.

Let the curves A and A_1 (fig. 1) represent the electromotive force

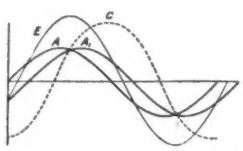


Fig. 1.

waves of two alternators with their armatures connected in series, the machines been driven independently, but so as to give the same frequencies and pressures, and suppose them to be running synchronously, but to be out of step by a small angle.

The curve, E, represents the algebraic sum of the ordinates of A and A_1, and hence represents the resultant electromotive force of the two machines.

The current curve, C, lags behind the resultant E.M.F. curve E, on account of self-induction.

Now, the total work done in the circuit equals the product of the sums of the E.M.F. and current waves respectively, that is, the product of the ordinates of the two curves E and C. The work done in the circuit by either machine equals the product of the ordinates of its E.M.F. and current curves, that is, of its E.M.F. curve and the total current curve C, which is the same for both machines.

Since the pressure wave, A_1, of the lagging machine is nearer to the curve, C, than that of the leading one, it is quite clear that the products of its ordinates, and those of the curve, C, will be larger than those of A and the curve C.

Therefore the lagging machine, A_1, is furnishing more work to the circuit than the leading machine A.

If the two machines were rigidly connected, either on the same shaft, or by other mechanical means, this condition of things would continue indefinitely.

In practice, however, the machines are generally driven by separate belts or engines, and in this case, if connected in series with the leading machine, the lagging machine, being more heavily loaded than it, tends to slow up and lag more.

Clearly the more it lags, the more work it supplies to the circuit, and by reason of this lags more still, and so goes on until the pressure waves of the two machines are exactly opposed. The machines are now in stable equilibrium, but supply no power to the circuit.

If they were started exactly in step, they would do equal work, but the least mechanical disturbance to either of them would cause it to fall out of step, as described above.

The condition of equilibrium is then unstable, and it is therefore impossible to run alternators in series, unless they are rigidly connected on the same shaft, which is in nearly every case, either of alternators in series or in parallel, impracticable.

Alternators in Parallel.

The possibility of running alternators in parallel is due to their reversibility, or ability to act as synchronous motors.

We know that an alternator connected up to another alternator which has been brought up to synchronism and voltage, will run it as a motor, and that there will be a very powerful tendency in the motor machine to keep in synchronism with the generator.

A considerable load may be put on it, and still it will keep in synchronism.

In fact, it is essential to an ordinary single-phase motor that it should be in synchronism with the generator.

A precisely similar thing happens with alternators running in parallel, for if one, by reason of mechanical or electrical disturbances, tends to slow up, the other will pump current into it, run it as a motor, and hurry it up into synchronism again. So strong is this effect, that if the machines are thrown in in parallel when they are in direct opposition of phase, they will right themselves in time, provided, of course, that they are in synchronism, or nearly so.

However, we shall return to this later on.

For parallel working the speed must be uniform, and if the cranks of the two engines are crossed, each machine will tend to alternately speed up and speed down, for when one engine pulls, the other will be at its dead point.

If the governing is not good, and the fly-wheels not heavy enough, the armature reactions will set up a kind of hunting or pumping action, and a consequent fluctuation of the lights with each period of the engine's revolution.

If the engines have two cranks, this will, of course, be obviated. More need not be said on this part of the subject, as it is not exactly within the province of this paper, and has been already so excellently dealt with by Mr. Wilson in his paper on "The Parallel Running of Alternators."

We will now pass on to the results of putting two alternators, which are out of synchronism, in series with a negligible load such as a lamp.

It may simplify matters to liken the two machines to two pendulums of slightly different lengths.

If the pendulums are started swinging in phase, they will, after a short time, get out of phase, until when one is swinging in one direction the other is swinging in the other, and similarly, in the same space of time which they took to get out of phase they will get into phase again.

Two alternators will behave in exactly the same way when they are connected in series but are out of synchronism. At one moment they will supply a voltage equal to the algebraic sum of their voltages, and the resultant voltage will be a maximum, and as time goes on, they will oppose each other, and the algebraic sum will be the arithmetical difference, therefore we shall have a minimum resultant voltage.

In fig. 2 you will see the two black curves, which represent the

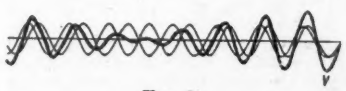


Fig. 2.

curves of two alternators slightly out of synchronism. The red curve is obtained by taking the algebraic sum of the ordinates of the two black curves, and you will see from it that the resultant voltage grows and dies away. The more nearly the machines are in synchronism the slower will the fluctuations be. This effect is very important as it is made use of in most synchronising apparatus.

We have here a model to illustrate it. A commutator and two slip rings are mounted on a shaft and revolved at a high speed by a motor. Each slip ring is connected to one half of the commutator, and has a brush pressing on it.

A continuous current is lead in at these brushes, and if two more brushes are put on the commutator at opposite ends of a diameter, we can get from them an alternating current. We have another similar commutator with travelling bearings, and it is arranged so that by sliding it along we cause a little rubber-banded wheel on it to move along a cone attached to the shaft of the first commutator. We thus have the speed of the first commutator fairly constant and that of the second variable.

We can now consider them as two little alternators, and though if connected in series with a lamp they will behave as described above, causing the light of the lamp to periodically grow and die away, either slowly or fast according to the position of the wheel on the cone, they cannot, of course, be actually synchronised because there is no sort of dynamo and motor action between them, and nothing corresponding to armature reactions.

Let us now consider the effect of throwing in two machines in parallel, regardless of step, but having got them up to synchronism first.

Immediately they are put in parallel, a current will oscillate between them, which, if they are in direct opposition of phase, may be enormous, especially in ironless armatures, in which case it will probably destroy them.

This enormous rush of current will, if the armatures stand the mechanical and electrical strain caused by it, slow up one of them a little, and they will get out of synchronism and begin that kind of see-saw action which will bring them into phase, and motor actions will start between them and bring them into synchronism. All this may sometimes take several seconds to accomplish, during which time the lights blink and go up and down.

This naturally limits the use of this method of throwing in absolutely to motor circuits, and also limits it to machines with ironclad armatures. If we were to do it in the case of ironless armatures such as Ferranti's, Mordey's, or Siemens' there would be such a rush

* Read before a meeting of the students of the Institution of Electrical Engineers on Wednesday, March 22nd, 1899.

of current as not only to destroy the armatures by mechanical shock, but perhaps to burn them out. In the case of ironclad machines, especially those with big teeth, the self-induction is so large that the current is limited, besides which all the mechanical strain is thrown on the iron and none on the conductors. Commercially, however, alternators are hardly ever thrown in in parallel regardless of step, and in the very few admissible cases it is done with ironclad armatures and motor circuits.

It may be well to mention that it is found that machines of the same type and wave form have the most synchronising power. As regards the last condition, it has been said before that slight inequality of voltage does not much matter, and is, in some cases deliberately arranged for, when it is desirable to throw more load on to one machine than on to another.

Methods of Synchronising Alternators.

The simplest form of synchronising apparatus is shown in fig. 3. A_1 is the alternator already running and connected to the bus bars. A_2 is the alternator to be thrown in. When the switch of A_2 is off

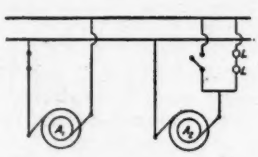


Fig. 3.

and the little auxiliary synchronising switch (which is not shown) is on, when tracing out the connections, you will see that the machines are in series with the two lamps, L L. As A_2 comes up to speed, the light of these two pilot lamps will flicker, and the flicker will get slower and slower as the speeds get more nearly equal, until the light takes about two seconds to grow and die away.

All this time the operator has been carefully regulating the voltage by means of a rheostat in series with the field coils. When the vibrations get just to the right speed, which is a matter of judgment and experience, the operator waits till the light in the pilot lamps is very nearly at a minimum, and then switches in sharply. Now, when the dynamos are out of phase as regards the synchronising circuit, that is, when the lamp is at a minimum, they are in phase as regards the bus bars, for the one is a series circuit and the other a parallel.

We have then the following condition of things when the operator has switched on:—The machines are in phase, but very slightly out of synchronism, and it has been already explained that if a machine has been slowed up a little bit, the other or others will run it as a motor, and hurry it up into synchronism, provided they are in phase. The machines will now go on quietly running in parallel. It is by no means such an easy job as it sounds, and if the man doing it switches on too late, when the machines are out of step, he may do considerable damage, and if it is a lighting circuit bring down torrents of wrath and indignation upon the heads of the company for whom he works. Even old hands seem to have to concentrate all their attention on their pilot lamps and voltmeters when synchronising, and seem to be in a sort of "Do not speak to the man at the wheel" frame of mind.

(To be continued.)

INTERMEDIATE RECEIVERS ON ELECTRICAL TRACTION ENGINES.

[COMMUNICATED.]

It is an axiom of the steam engineer that the best results from a steam engine are to be sought for only when the cylinders are dry throughout. A wet cylinder implies re-evaporation, and re-evaporation causes initial condensation. The effect is cumulative, and many engines have an initial loss of 50 per cent. of the steam admitted. A shallow thinker might demand that the steam should be so far superheated that the additional heat was equal to the missing latent heat of the quantity condensed. This is now recognised as an erroneous view. The action of superheat is also cumulative. It begins by reducing the amount of initial condensation; less re-evaporation takes place, and this means less condensation again. In the course of a few revolutions the action of superheated steam would show itself in a comparatively very large saving.

It is thus held that an initial superheat of 100° might stop all condensation. Whatever be the figure, in any one case it is clear that the steam should be dry when it exhausts to the condenser. In compound engines this is sought to be attained by intermediate reheaters. Now it is very questionable whether an intermediate receiver in a traction generator engine is a thing in the right place, and a reheater must be more or less of a receiver. Perhaps it matters less in engines of high speeds of revolution, but in slow speed engines the variations of load are so numerous and so sudden, that there must often be times when steam is cut off the high pressure cylinder by the governor and is acting on the low pressure cylinder from the receiver with an undesirable energy, for the receiver has become full of steam and proceeds to empty itself into the low pressure cylinder. This cylinder hurries round the unloaded engine at a high velocity, and forces the governor to a position beyond what is necessary, still further depleting the high pressure cylinder of steam. Then the load is thrown on by a number of cars starting on an uphill road. By this time the receiver is empty of steam, and only the high pressure cylinder is capable of doing work until the low pressure cylinder can again commence to draw from the receiver. The engine cannot run at speed; the governor throws more steam upon the high pressure cylinder, and presently the engine is full of steam, and the load goes off again just when the engine is fit to deal with it. Such, modified by fly-wheel energy, is the action of the compound receiver engine, and such, still more, is the action of the triple expansion engine.

The slower the number of revolutions in a unit of time, the more pronounced such irregular action must be.

It is assumed, of course, that the low pressure valves are fixed at about the customary $\frac{7}{10}$ths cut-off. It would almost appear that with slow speed engines the low pressure cut-off should be actuated exactly as the high pressure cut-off, or that some easily actuated throttle valve should be worked by the governor to cut off steam from the large cylinder. With such a provision there would be ready for the next load period a receiver full of hot steam to give energy at once to the large piston, while upon the load being reduced, the receiver pressure would rise against the small cylinder.

This aspect of the compound engine leads to the consideration whether the simple engine and superheating could not with advantage be employed on variable loads. The principle economy for compound working has been because of the evil of cylinder condensation which it has to some extent counteracted. But if there was no cylinder condensation nothing need be done to combat it. In a simple condensing engine there is, of course, always the accelerating influence of the condenser to deal with. If this exceeds the light load of an engine it would be possible for the engine to run away and bring into action the knock-off motion. This is undesirable, and should be met by a provision for cutting out the condenser in the same way as suggested for cutting out the receiver.

The history of electrical traction in America has been a history of many smashes, and its results have been twofold. On the one hand high speed engines have been more employed; on the other hand the low speed engines have been weighted with a large friction brake in the shape of unusually large crankshafts upon which very heavy fly-wheels have been placed to give pressure. The moment of friction has been rendered large, and the fly-wheel energy also has been made considerable. These two items between them have served to hold engines steady under the accelerating influence of the condenser at light loads. The method appears somewhat unscientific, and does not commend itself as an economical method. It is practical—this is undeniable—in fact, it is painfully practical, for it substitutes an internal power wasting brake for some means of regulation of the source of power. The benefits of condensation may be swallowed up in journal friction. It is satisfactory to find the journals of such excessive length. This has been complained of. There is no cause for complaint. Given such huge diameters, there must be great friction and consequent heat. The heat must be dissipated by a sufficient surface, and length forms a convenient means of securing surface. In slow speed engines it should be possible to regulate the energy given by the steam in place of wasting it.

THE CANDLE-POWER OF ARC AND INCANDESCENT LAMPS.*

The Appropriate Light Unit.

By Prof. WILBUR M. STINE.

The action of the American Institute of Electrical Engineers and of the National Electric Light Association in giving official indorsement to the opinion of scientists who have carefully investigated the subject, legalising the amyl acetate lamp as the standard of illuminating power, renders all forms of candles obsolete for light standards. Relinquishing the candle as the concrete light standard, should the term candle-power be given up or retained?

For illustration, suppose the meter were the legalised standard of length, and that this action was generally accepted and measurements were made with metersticks instead of foot-rules, would it be advisable to employ the ratio of the meter to the foot, and having made the measurements with the meter unit, to express the measured dimensions in feet?

* *American Electrician.*

Much the same dilemma presents itself to photometrists. Scientifically and legally, candles are no longer in repute, and the amyl acetate standard is the new unit of light strength. Shall a ratio between the amyl acetate lamp and the candle be employed and all determinations of the light strength of illuminating sources made against the amyl acetate standard be finally expressed in candle-power terms? The first step towards an intelligent decision is the consideration of the ratio between the light strengths of the amyl acetate lamp and the candle.

It has been insisted upon that experimental evidence has shown that the light strength of the candle is a widely varying and uncertain quantity. Abandoned for this reason, it is vain to seek for a definite ratio between the amyl acetate lamp and the candle, or between any constant standard of light and the candle. The numerous candle-power ratings in the literature of photometry are only mean values obtained between wide extremes, or merely figures, and represent no physical quantity. Violle, a French physicist, states the ratio as low as,

$$\frac{\text{English candle}}{\text{Amyl acetate lamp}} = 1{\cdot}02.$$

The German Physical Institute places it at 1·14, and other investigators as high as 1·22.

The term candle-power being meaningless as a quantitative expression, and the amyl acetate lamp being fairly precise as a standard light, we, in this country, might follow the example of foreign photometrists and express illuminating power in terms of Hefner units (Hefner Licht, is the current term in Germany). It might be especially desirable that the manufacturers of incandescent lamps should begin the innovation by marking their lamps in Hefner units instead of candle-power. An inconsiderable increase in illuminating power, and probably the majority of lamps would need none, would change the present candle-power ratings to conform to the new scale of:—

10	C.P.	12 Hefner units.
16	„	20 „
20	„	25 „
25	„	30 „
32	„	40 „

A reasonable objection to such an innovation in lamp ratings is that the change once made, a better light standard than the amyl acetate lamp might be introduced, and the necessity would arise for a second revision of lamp ratings, and so on without an end. Referring again to the analogy between this subject and the meter as a standard of length, it may be advanced that the meter is a purely arbitrary standard of length, though it was designed to be an absolute one, and for similar reasons the candle-power may be retained as an arbitrary light unit both in name and assigned value. The analogy is only apparent, for there can exist no material representation of the candle-power unit of light, because it is an indeterminate quantity. Candle-power is then a mere name corresponding to no physical quantity, and in the adoption of the Hefner unit along with the material amyl acetate standard, there is in reality nothing to relinquish but a mere custom. According to an established scientific custom, there is no inconsistency in naming the unit of light after an individual connected with its development. The custom itself, though now seemingly general and firmly established, is perhaps a questionable one. In the old mythology every aspect of nature was personified and named, and though the application has changed, the principle still survives in scientific practice.

The more rational procedure would be that followed in reference to heat. A quantity of heat is expressed in terms of heat units or British thermal units. This is thoroughly scientific, entirely satisfactory, and produces no confusion whatever. There are certain interested parties now at work, however, who are anxious to impose the name of an individual upon the heat unit, but as the change is unnecessary, it is to be hoped that engineers and physicists will be conservative and adhere to the prevailing practice and continue the use of the term "heat unit."

Let us apply the same reflections to the discussion in hand. Abandoning candle-power units and such descriptive and personified terms, let the illuminating power of all sources of illumination be expressed in light units simply. This is entirely expressive, and can lead to no confusion whatever. The value of the light unit applied to the candle, Methven screen, and such indeterminate light sources, cannot be expressed because of variations in the light strength. But applied to the amyl acetate lamp it is a quantity whose value can be stated within very narrow limits of uncertainty. As the science of light standards advances and the light strength of the actual standard becomes expressible with very great precision, the term Light Unit will still apply with equal force. If the value of the Light Unit is changed by consent of a congress or other body, it will cause no more confusion than was occasioned by the change in the value of the Heat Unit by a redetermination of the mechanical equivalent of heat.

The unit for expressing the quantity of a phenomenon must be of the same character as the thing measured, and this unit value can be no more precise than the value of the thing measured. As the measurement of the phenomenon grows more and more precise, to the same extent will the value of the unit become more definite.

Adhering still to the descriptive designation of the light unit, it has been proposed to call it the "Photon." This would be a perfectly general descriptive term applying equally to all standards. Should the term Hefner unit prove objectionable, and a descriptive unit, based on the amyl acetate lamp, be desired, following the analogy of ammeter, the name "Amate" could be coined. But applying the criterion just established, both the terms photon and amate are objectionable, it being unnecessary to employ for such purposes an intellectual cipher code.

The Incandescent Platinum Standard.—Violle endeavoured to realise an absolute or simple and reproducible standard of light by employing a definite light giving area of an incandescent metal. He finally selected platinum as best adapted for the purpose. In order that the temperature of incandescence which he used should be reproducible with accuracy, he selected the temperature of solidification of the metal. When a metal has been fused and begins to solidify, its temperature remains constant until the change of state has been accomplished. Though the same thing is true for the act of fusion of a metal, there are reasons, discussion of which would prove tedious here, why the temperature at which fusion occurs is not always the same, but varies with the past history of the metal. Platinum, in common with iron, for example, when solidifying, recalesces, or the light emitted suddenly flashes into greater brilliance, for a very short time. Violle, taking advantage of this, selected the moment of recalescence or flashing during solidification for the determination of the light strength. The mass of platinum, about 1 kilogramme, was melted by a compound blow-pipe in a lime crucible. After the fusion of the platinum the crucible was placed immediately under a water-cooled screen, pierced with a circular hole of the area of 1 square centimetre. During the flashing period the surface of the incandescent platinum was found to emit a light strength nearly 19 times as great as that of the amyl acetate lamp for the square centimetre. This standard was legally adopted, though largely hypothetical, by the Paris Electrical Congress of 1881. Subsequent experiments have not confirmed the utility of this source of light, and the attempt to realise a precise standard of light from incandescent platinum has been practically abandoned.

To Recapitulate.—The leading standards of illuminating power proposed and actually used are candles, the Methven screen, the pentane and amyl acetate lamps, and the carbon arc and incandescent platinum standards.

REVIEWS.

Analyses Electrolytiques. By A. Minet. Gauthiér-Villars, Paris, 1899.

This is the fifth text-book which the author has contributed to the "Encyclopedie Scientifique" series, edited by M. Léante, the other four having dealt with theoretical and industrial electro-chemistry and electro-metallurgy.

The volume is well printed, and contains 170 pages and 18 wood-cuts, illustrating the text. Within this small compass

a considerable amount of information concerning the theory and practice of electrolytic methods of analysis is contained. We are afraid, however, that M. Minet has sacrificed usefulness to limits of space; and that in his desire to be brief and concise he has produced a work that will be of limited service to the student of the subject.

Electrolytic methods of analysis are of most beautiful and remarkable simplicity—on paper. In practice, however, they are chiefly notable for the amount of bad language which they produce on the part of the unlucky experimenter. And accuracy is only obtained by rigid attention to details of procedure which the novice is disposed to think of no account.

The author would therefore have done better had he devoted more space to details of manipulation and electrolytic deposition.

The arrangement of the chapters is good. Chapter I. is devoted to general principles, and to a description of the apparatus and reagents required. The author regards accumulators as the safest sources of currents for laboratory work. Chapters II. and III. are devoted to brief descriptions of the various methods of separating the metals and non-metals from pure solutions of their salts.

This is the portion of the work that might have been greatly extended, and references to the original researches upon which the methods are founded ought to have been given as footnotes, so that students might know where to turn for further information when difficulties had arisen. Not a single reference to the original literature of the subject has come under our notice in these two chapters, and this defect greatly reduces the value of the work.

Chapter IV. is devoted to details of the methods employed for the electrolytic separation of two or more metals, and Chapter V. to a brief account of the methods worked out by Holland for the electrolytic analysis of commercial copper, brass, and lead.

These two chapters might also have been greatly amplified with benefit to the book as a whole.

The facts and figures are correct so far as we have been able to check them, but surely 5 amperes on p. 107 ought to be 0·5 ampere; and the maximum weight of manganese determinable as manganese peroxide, is 5 to 7 times that stated by the author on p. 110.

The book lacks a good index.

Students and chemists may be able to obtain a general knowledge of electrolytic methods, as used in the chemical laboratory, from this small hand-book; but we doubt whether they will be able to obtain accurate and concordant results without recourse to the larger text-books of Smith, Classen, and Neumann, on the same subject.

The Electrical Engineer's Central Station Directory. London: Biggs & Son.

This directory has now reached its third edition. Like everything else electrical, it has developed considerably during the past couple of years. In a very convenient form, the principal features of the electricity supply systems throughout the country are placed before the reader, and where it has been possible to obtain them, load curves accompany the notes. A later section of the work gives some general notes under the heading "Stations Contemplated." Financial returns of certain electricity undertakings for the years 1896 and 1897, provisional orders existing and applied for, and a copy of the Board of Trade Electric Lighting Regulations complete the electric lighting section. A few notes *re* electric tramways and railways now operating and on paper, follow, and we note that there is a "Biographical Section," in which are photographs of some of our electricity works' engineers.

Schemes on Paper.—Ambitious electric railway schemes are plentiful just now. An American party talks of running an electric line between London and Brighton at high speed and low fares, while the sanguine supporters of the single-rail system propose to construct an electric line between London and York, the speed on which will be 120 to 200 miles an hour.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

16,903. "Improvements in electric ignition devices for petroleum, oil, and analogous motors." H. Guillame. Dated August 21st.

16,922. "An improved electric spark fuse." G. G. M. Hardingham. (O. R. Schulz, Germany.) Dated August 21st.

16,926. "Improvements in or relating to electric measuring and indicating apparatus." H. Darwie, E. H. Griffiths, and W. C. D. Whetham. Dated August 21st.

16,928. "Improvements in magnet separators." A. Dings. Dated August 21st.

16,956. "Improvements in or relating to conduits for electric conductors." J. J. Bate. Dated August 21st.

16,959. "A new or improved device or tool for fastening insulators for electric wires to the ceilings of rooms and other similar places." G. Dornauf. Dated August 21st.

16,960. "Improvements in rheostats and means for operating the same." C. de Kando. Dated August 21st. (Complete.)

16,980. "Improvements in or relating to electric incandescent lamps and their conducting wires, also applicable to the conducting wires of telephonic and other electrical instruments." W. Gunn. Dated August 22nd.

16,997. "Improvements in rail-bonds for electric railways and other purposes." A. J. Boult. (F. H. Daniels, United States.) Dated August 22nd. (Complete.)

16,999. "Improvements in magneto-electric telegraphs." L. G. Woolley. Dated August 22nd. (Complete.)

17,031. "Improvements in effecting contact with the active matter of accumulator plates and the like." W. P. Thompson. (C. Payen, France.) Dated August 22nd.

17,033. "Improved method of and device for switching on and off the incandescent filaments of electric incandescent lamps or the bodies serving for preliminarily heating incandescent bodies of conductors of the second class." J. Gyorffy. Dated August 22nd.

17,052. "Improvements in or connected with electric batteries." J. Y. Johnson. (Chemische Fabrik vorm. Goldenberg, Geromont & Co., Germany). Dated August 22nd.

17,130. "Improvements in automatic electric alarms." W. Rausch. Dated August 23rd. (Complete.)

17,159. "Improvements in electricity meters." G. Hookham. Dated August 24th.

17,203. "An improvement in pole pieces for dynamos." H. A. Earle. Dated August 24th. (Complete.)

17,211. "Improved holder for telephones." W. H. Wheatley. (M. Wohlgemuth, United States.) Dated August 24th.

17,229. "Improvements in connection with the polishing or finishing of electro-plated and other articles." J. B. Brooks and J. Holt. Dated August 24th.

17,246. "Improvements in automatic electric testing apparatus." R. J. Wallis-Jones. Dated August 25th.

17,256. "Electric log recorder." L. T. Jones, jun. Dated August 25th. (Complete.)

17,257. "Improved apparatus for generating electrical pressure." G. E. Adams. Dated August 25th.

17,258. "Improvements in or relating to galvanic batteries." A. J. Boult. (J. Trillet, France.) Dated August 25th. (Complete.)

17,260. "Improved means for charging the accumulator batteries of electric motor vehicles." H. Leitner. Dated August 25th.

17,261. "Improvements in secondary batteries." H. Leitner. Dated August 25th.

17,262. "Arrangement of connections and conductors for railways worked by electricity." G. Winter and E. Futter. Dated August 25th.

17,263. "Improvements in connection with electrical measuring instruments employed in combination with current and potential transformers for measuring electrical energy." Siemens Bros. & Co., Limited. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated August 25th. (Complete.)

17,304. "Improvements in incandescent lamps for electric lighting." H. Very. Dated August 26th.

17,319. "Improvements in grips used in the laying of underground electrical cables." The Steel Nut and Joseph Hampton, Limited, and S. Hampton. Dated August 26th.

17,326. "An improved electrolytic current interrupter or circuit breaker for induction coils." W. P. Thompson. (Voltohm Electrizitäts Gesellschaft A. G., Germany.) Dated August 26th.

17,337. "An improved battery cell with double case." C. Vogt. Dated August 26th. (Complete.)

17,341. "Improvements in or connected with contact apparatus for electric railways with underground current feed and mechanical partial conductor service." C. F. P. Stendebach. Dated August 26th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

331. "Improvements in preventing sparking when making and breaking electric circuits." A. Muller and H. Tudor. Dated January 5th, 1898. Relates to improvements in preventing sparking when making or breaking electric circuits. Consists in introducing into the circuit before making or breaking the current a polarisation battery or condenser in series with the current source and the consumption apparatus to stop the flow of current before the making and breaking of the circuit." 4 claims.

586. "Improvements relating to the mounting of dynamo-electric machines." P. R. Jackson and J. S. Lewis. Dated October 7th, 1898. Relates to the mounting of dynamo-electric machines. To carry out the invention two rails are provided, laid in concrete. Between the rails at that part where the engine is to be secured is placed a third rail to act as an additional support. The dynamo is placed with its shaft parallel with the rails, and the pedestals supporting the shaft are secured to bridge pieces which are grooved on their undersides to fit the supporting rails. 2 claims.

698. "Improvements in or relating to electric illumination of railway trains." B. de Szwantowski. Dated January 10th, 1898. Relates to an arrangement whereby the force of the air currents caused by the motion of the train is so considerable, that even without a head or adverse wind the train experiences an air pressure which actually represents in strength a strong wind. The apparatus consists of a wind wheel which serves to drive a dynamo, and which is driven by a current of air produced by the movement of the train. 4 claims.

812. "Improvements in or relating to dynamo-electric machinery." P. R. Jackson & Co., Limited, and J. S. Lewis. Dated January 11th, 1898. Relates to dynamo-electric machinery and comprises an improved construction of commutator. In the construction of the commutator the blades or segments, preferably with the radial strips attached are arranged in position with insulation between. They are then forced together so as to form a rigid cylinder. Insulation is then placed round the ends of the bars over a rebate formed on the external periphery, and a steel or iron ring is shrunk on at each end of the cylinder. 5 claims.

1,021. "Improvements in the manufacture of filaments for incandescence electric lamps." C. H. Stearn. Dated January 13th, 1898. A solution of cellulose is employed. It is made by treating cellulose with strong alkali, and then with carbon bi-sulphide and dissolving the product in water. Cellulose is precipitated in a filamentary form by projecting the solution into a precipitating solution such as alcohol. The filaments are then purified by treatment with any of the usual reagents and carbonised. 5 claims.

1,628. "Improvements in and relating to secondary batteries." W. A. Crowdus. Dated January 20th, 1898. Relates to secondary batteries in which the elements are formed by mechanically applying lead salts in the form of paste to metal plates or supports. In order to separate the plates a corrugated non-conducting separator composed for example of India-rubber. The negative plates of the battery are formed by immersing conducting plates coated with lead or oxide in a solution containing sulphuric acid and a sulphate of an easy oxidisable metal such as zinc and passing an electric current through the solution. The positive elements are first formed into negative elements and then forming them into positive elements by reversing the direction of the flow of current. 4 claims.

1,687. "Improvements in electric signalling apparatus." S. P. Thompson. Dated January 21st, 1898. This relates to the apparatus known as coherers, used for receiving electric waves in space telegraphy. Instead of using a solitary point contact or an incoherent mass of filings as heretofore, a number of discreet conductive wires are employed, arranged in series or in parallel, or in series and parallel; in light contact with means for regulating the contact pressures. Clean wires of nickel, brass, or tinned copper, so arranged, are found to work excellently. Or the contacts may be between different metals or between metal and carbon. In some cases the coherer is mounted upon a vibrating sound-board, or upon a mechanical or electric tapper, such as a clock or electric trembler. In some cases the contacts are made between stationary and revolving surfaces. 3 claims.

1,809. "Automatic switch or cut-out." E. A. Claremont. Dated January 22nd, 1898. Relates to a means for constructing a switch controlled by an electro-magnet and so arranged that on the electric current exceeding the normal the switch will be released in any predetermined time proportional to the excess of current. 1 claim.

2,167. "Improvements in and connected with electric generator for cycles and other vehicles." J. Moores and H. O. Farrell. Dated January 27th, 1898. An electric generator to be applied to a cycle or other vehicle, and driven by one of the wheels, mounted on suitable bearings or supports, on which the said generator can rock. 1 claim.

2,299. "Improvement in joints between the glass globes of electric arc lamps and the supports by which they are carried." P. H. Guerin. Dated January 28th, 1898. The apparatus consists of a globe provided with a channel forming a hydraulic or sand joint and a cylinder of a diameter to fit the recess and fixed to the sides or bottom of an electric arc lamp in order to reduce the consumption of the carbons. 1 claim.

2,427. "Improvements in variable electric resistances or rheostats." R. Waygood & Co., Ltd., and P. J. Unwin. Dated January 29th, 1898. Relates to resistances which are especially suitable for the electric starting switches for the electric motor of lifts, &c. Consists of a badly conducting powder, such as flake graphite, and a blade or plunger which is inserted more or less into it. 3 claims.

2,522. "An improved electrical striking mechanism for bells." A. Eckstein and H. J. Coates. Dated February 1st, 1898. The striker is attached by a long arm to one end of a lever near the fulcrum. To the long arm of the lever a plunger is attached. This plunger, when a current is passed through a solenoid, is drawn into it pulling its end of the lever down. This raises the striker and it hits the bell. When unenergised the weight of the hammer makes it hang nearly perpendicular. 1 claim.

2,684. "Improvements in apparatus for the electro-deposition of metals." F. Fisher, B. J. Round, B. J. Round, A. Round. Dated February 2nd, 1898. Relates to improved apparatus to be employed in the process of electro-plating. Consists of a rotating vat or vessel containing the electrolyte and the work to be plated arranged in connection with an inclined driving shaft and having an open mouth of less diameter than the closed bottom, which is provided with an attached metal ring or equivalent cathode element in connection with an outside conductor for the return current, whilst the anode element is suspended within the electrolyte in the vat by means of an adjustable and swinging rod. 3 claims.

2,761. "Improvements in high tension electric switches." E. W. Cowan and A. Still. Dated February 3rd, 1898. Relates to switches of the Hatchet type. Consists in constructing the switch with contacts in recesses and with slotted guard plates with hoods in combination with them. 3 claims.

2,784. "Improvement in electric switches." O. C. Immisch. Dated February 3rd, 1898. Relates to an improvement to prevent sparking at the switch connections. When the switch is actuated, before the existing connections are broken, the switch contact piece is first caused to establish a connection by which a path for the current is established through an electro-magnet, which as soon as it is excited, is drawn into its helix, which movement breaks the circuit. 1 claim.

3,802. "Improvements in or connected with electrical conductors." H. Edmunds. Dated February 15th, 1898. Relates to positions where only one wire may be used, but a return wire is needed. There is an inner conductor covered with lead, and that is covered with another coating of copper which acts as a return wire. The copper may be coated with an electro-deposition of gold, silver or the like to protect it. 3 claims.

3,748. "A method of oxidation and bleaching by means of electrolysis." J. G. A. Rhodin. Dated February 15th, 1898. Relates to a method for the oxidation and bleaching of textile materials by means of apparatus such as that described in Specification 21,509, 1896. In carrying out the invention the carbon anode, described in the above specification, is replaced by anode of iron or other suitable materials. The inner compartment is filled with a solution of caustic soda, the outer compartment being filled with water. The caustic soda is subjected to electrolysis with a result that the alkaline metal is by means of the mercury transferred to and absorbed by the water in the outer vessel. Oxygen is being formed and partly liberated whereby a strong oxidising agent is formed. 2 claims.

4,514. "Improvements in electrolysis and cathodes therefor." V. I. Feeny. Dated February 23rd, 1898. Relates to the cathodes for electrolysis. Consists of covering the cathode with a layer of sulphide and polishing it. The deposited metal can then be easily removed by breaking or brushing. The metal broken away is polished. The sulphide of the metal cathode may be obtained by rubbing the metal with sulphur and water. 3 claims.

4,624. "The electrolytic manufacture of alkaline bichromates." J. Heibling. Dated February 24th, 1898. Relates to a process for the electrolytic manufacture of alkaline bichromates: The process consisting essentially in subjecting to the action of an electric current by means of anodes of chromium or alloys of chromium, a solution of alkaline chlorides contained in an electrolytic vat. The same result can be obtained by employing a solution of alkaline nitrates, and the process can also be carried out by using as the electrolyte a solution of caustic alkali. 3 claims.

5,034. "Improvements in or relating to electrolytic meters." C. O. Bastian. Dated March 1st, 1898. Relates to electrolytic electrical meter. Consists of a glass frame or open work support with thin sheets or surfaces of platinum or equivalent material mounted opposite one another on the frame so that they cannot come in contact, and means to attach the sheets to the frame two vertically extending glass tube connected to the frame, and two conductor wires in said single tube and passing out therefrom, and respectively connected with the circuit wires and the platinum sheets. 11 claims.

5,379. "Improvements in the manufacture of submarine telegraph and telephone cables." W. T. Henley's Telegraph Works Company, Limited, and G. Sutton, and L. L. Hartelgson. Dated March 4th, 1898. Relates to a protective covering for cables. Consists of a protective armouring of two open windings of galvanised iron or steel tape, the second winding covering the intervals between the convolutions of the first. 1 claim.

6,147. "Improvements in the electrolytic treatment of ores and slimes for the recovery of precious metals therefrom and apparatus therefor." H. Riecken. Dated March 12th, 1898. Relates to the electrolytic treatment of ores and slimes for the recovery of metals, chiefly gold. Consists of an open vat made of wood lined with copper at the sides and bottom. The copper is silver-plated. The sides are inclined. At the bottom is a trough for the collection of mercury, and at the top a perforated pipe for distributing the mercury over the sides. The gold forms on the copper sides over which the mercury flows. The anodes are of carbon fixed to a shaft which traverses the vat and which is rotated or oscillated by any suitable means. It is connected to the + pole of a dynamo, the lining of the vat being the − pole. 6 claims.

6,991a. "Improvements in index needles or pointers for electrical and other indicating or measuring instruments." E. Weston. Dated March 22nd, 1898. Relates to index needles. Consists in having short arms running radially from the pivot and attached to the pointer, so that specially constructed nuts can be screwed on to counterbalance the weight of the needle. The arms are at right angles so as to form a cross with the needle for the longest arm. The whole is made of aluminium so as to give lightness. 20 claims.

6,992. "Improvements in electrical measuring instruments." E. Weston. Dated March 22nd, 1898. Relates to improvements in electrical measuring instruments. Consists of an electrometer provided with a stationary electrostatic field and a movable electrostatic armature or needle adapted to move in said field in combination with an indicating needle attached to or carried by the electrostatic armature or needle, a calibrated scale, and an independent indicating needle all enclosed in a casing, the independent indicating needle being provided with means extending through the casing for moving it by hand to any predetermined point whereby comparative reading may be taken at a distance. 22 claims.

9,436. "Improved means for electrically heating second class electric conductors serving as incandescence bodies for imparting to them the requisite conducting power." M. Deri. Dated April 23rd, 1898. Consists in the employment of an electrical heating body of very weak conducting power, so as to offer so great a resistance to the current that the resulting heat will be transmitted to the conductor of second class, constituting an incandescence body surrounding the heating body, for imparting to this the requisite conducting power. 1 claim.

10,225. "An improved method of casting electric accumulator plates and apparatus therefor." J. Hesse and J. Kernaul. Dated May 4th, 1898. Relates to the casting of accumulator plates having tapering projection on them to hold the active material. The ridge plates are cast in the form of an arc or circle instead of casting them directly as desired, and, after casting, bending them into a straight shape. 3 claims.

14,833. "Improvements in and connected with junction boxes for electric cables, inspection chambers and the like." F. Franklin. Dated July 6th, 1898. Relates to ventilated junction boxes which prevents dirt or wet getting in. Consists of a frame having a flange adapted to rest on brickwork, and a channel surrounding the upper part. Holes are formed in the channel. A cover fits on the frame and has ventilating outlets round the edges. To prevent water entering through these a bead is cast round the underside of the cover. 3 claims.

15,885. "Improvements in electro-magnetic ore separators." H. Langguth. Dated July 20th, 1898. Relates to electro-magnetic ore separators in the form of a wheel or rim, consisting of a single rotary electro-magnet with cylindrical or pan-shaped poles of U section situated opposite each other. 2 claims.

16,245. "A new or improved electric sounding device." J. P. Buckley and W. A. Croffert. Dated July 26th, 1898. Relates to long distance sounding apparatus for ships. Consists of a shell or casing containing a liquid contact maker and connected by electric wires to an alarm device, viz., an adjustable float and adapted to be suspended without giving an alarm and when not or only partially suspended to give an alarm. 3 claims.

17,418. "Improvements in or relating to electric tumbler switch appliances and their base plates." C. Markt. Dated August 12th, 1898. Relates to improvements in electric tumbler switch appliances. The base is made of pottery and is provided with two raised cheeks in which screw holes are formed. Two pockets separated by a pocket into which during one operation of the switch the tumbler goes. The contact piece of the switch works upon a hinge and is held up by a spring. The lever is also on a hinge and is not fixed to the tumbler but is provided with a wheel which runs along the tumbler pushing it on to the partition between two holes in the base which is a contact piece. 5 claims.

18,531. "Improved means for electrically operating electric railway switches." R. A. Baldwin and H. Rowland. Dated August 29th, 1898. In carrying this invention an electro-magnet is located in a box in the roadway at some convenient point adjacent to the switch tongue. Current to actuate the magnet is taken from the return circuit of the railway which ordinarily is the rail. In order to do this, a short section of the rails ahead of the switch is insulated, and when the switch is turned the return circuit from the vehicle is passed into the insulated section of the rails then to the magnet and finally to the return circuit. 5 claims.

18,736. "Improvements in and connected with secondary or storage batteries." W. M. McDougall. Dated May 13th, 1898. Secondary batteries are arranged so as to minimise the vibration when mounted on vehicles and the like. The electrodes are made with projecting bosses in which are cut intersecting grooves reaching to the surface of the plate. The plates are covered on both sides with sheets of insulating material in which are holes to receive the bosses, and the sheets are of such a thickness that the bosses lie flush with their outer surface. Division plates are also placed across the electrodes. The plates are made of insulating material, finely perforated and with ribs on one side only, these ribs being turned towards the negative plates in the battery. The bosses may be replaced by projecting horizontal strips or webs, the spaces between which are filled with lead dust. 3 claims.

18,840. "Improvements in alternating current arc lamps." C. D. Abel. (H. O. Swoboda.) Dated September 5th, 1898. Relates to arc lamps in which the vibration of the feed magnets under the action of the alternating currents will not be transmitted to the lamp. 6 claims.

19,248. "Improvements in alternating current electric motors." W. P. Thompson. (C. S. Bradley.) Dated August 30th, 1898. Relates to electric motors having one core or element wound to produce a rotary magnetic field when supplied from a single-phase alternating current circuit, and a secondary core or element having its winding connected with an adjustable phase advancing device such as an electric condenser. 2 claims.

20,989. "A new or improved composition for electrically firing detonators." G. P. Bickford-Smith. Dated October 5th, 1898. Relates to a composition consisting of potassium chlorate, precipitated copper, precipitated silver, antimony sulphide, electrotype plumbago, and sodium tungstate in certain proportions. It is fired in a casing by an electric spark. 1 claim.